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A TREATISE ON THE LIGAMENTS.

By ASTLEY P. COOPER,

A

TREATISE

ON

LIGAMENTS.

By BRANSBY B. COOPER,

SURGEON AND LECTURER ON ANATOMY

AT

GUY'S HOSPITAL.

SECOND EDITION.

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SIR ASTLEY PASTON COOPER, BART.

Dear SIR,

Amongst other pleasures which I experience in offering this Book to the profession, that is not the least which arises from this public opportunity of expressing my feelings of affection and gratitude towards you, Sir, as the source of every advantage which I enjoy in life, and in my professional career.

Whatever merit may fall to my share from the publication of this Work, can only confirm the obligation which I have been gratified in avowing, by the conviction, that to you I am indebted for that knowledge which has given it birth.

Dear SIR,

Your grateful and affectionate Nephew,

BRANSBY B. COOPER.

TREATISE
ON
LIGAMENTS.

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PREFACE.

SIR ASTLEY COOPER'S recent book on dislocations has induced me to publish the present Treatise on the Ligaments, as an appendix to that work, in the hope of rendering it as useful to those who are commencing their professional pursuits, as it is to others, whose minds are already matured by study, and stored with practical observation.

Another reason, and one perhaps of equal importance, has cooperated in inducing me to publish, namely, the want of such a book in our language; for although the subject of this Treatise is to be found in the writings of various authors, surely it is of sufficient importance to justify, nay, even demand a work dedicated to its exclusive consideration: I trust, therefore, I shall not suffer from the imputation of having entered upon a path already too much beaten.

With regard to my feelings of diffidence in the execution of my task, it is needless to say, they are inseparable from a first attempt; and my apology for presenting myself to the notice of the public must be a hope, that, by comprising this branch of anatomy in a compendious form, I may prove of service to my profession.

I fear, still further, that I may be accused of plagiarism, in having copied from preceding writers both method, and matter, so great must be the similarity on all anatomical writings: in answer to that I would say, that though I cannot boast of much originality, still there is nothing advanced or described which dissection has not warranted and approved.

It is with feelings of the purest satisfaction, that I perceive the fulfilment of my hope of rendering a service to the profession evinced by the early demand for a second edition of the present work. In obeying this call, I have felt it a gratifying duty to add to its utility by every means in my power. With this view I have introduced some alterations into the plate of the hip-joint, which appeared essential to its accuracy; and in the detail of the work I have not neglected this opportunity of making such additions as appeared expedient.

I cannot allow this opportunity to pass without publicly thanking my friend, Mr. John Graves, for the trouble he has taken in making all the drawings from recently dissected subjects.

August, 1827.

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TREATISE

ON

LIGAMENTS.

As the purpose of the present Treatise is, not to construct a theory, but to detail facts in illustration of established principles, it would be needless and presumptuous to engage the reader's attention by a lengthened detail of preliminary disquisitions and introductory remarks. Equally irrelevant and tedious would it be to delineate a formal plan with a bewildering apparatus of sections and subdivisions, in reference to a subject so clear and connected, that it may be said to prescribe of itself the direct and very natural order in which the various particulars comprehended in it may be successively developed. That order may be at once perceived on reference to the table

of contents, from which it will also be seen that due attention has been paid to the pathology of this branch of anatomy, by describing, under their respective heads, the injuries to which the different articulations are liable from accident or disease. The same desire to avoid the inconvenience and obscurity which innovation often produces in creating new systems, has actuated me in the composition of the Treatise; respecting which I have merely to observe that in communicating the results of my researches, I have endeavoured to be as concise as possible on those points which have been illustrated by writers well known and appreciated by the profession; without, however, being restrained, by an excessive deference to received authority, from stating freely and fully my own reasonings and conclusions. I have for this purpose employed the plain and current language which appears best fitted for demonstration, making use either of popular or of scientific terms as the occasion seemed to require, but rejecting metaphorical ornaments and erudite phraseology, as savouring of affectation or of pedantry, and therefore equally inappropriate in a work which I could wish to be tried by no other test than that of practical utility.

Before I commence the description of ligaments, it will be necessary to make some few preliminary remarks on those parts which enter into the composition of joints, with the view

of impressing more clearly on the mind the important and peculiar offices which ligaments perform in connecting one bone with another.

When we examine the different connection of bones of the human body, we find them united by two distinct modes of articulation,—the one in which they are so firmly connected as scarcely to admit of motion,—the other, where motion may be freely exercised in almost every direction.

The first class may be divided into two different species of union, viz.: first, where the bones are in such immediate apposition, at several points of corresponding inequalities of surface, as not only to preclude the possibility of motion, but even to render their separation extremely difficult; as in the sutures of the cranium: secondly, where an intervening cartilage admits of some motion, accommodating itself only to peculiar circumstances.

This may still, in anatomical language, be termed an immoveable articulation, in contradistinction to those which are freely moveable, there being this characteristic difference,—that the motions of the former species, besides being comparatively slight, depend only on the application of mechanical force, whilst those of the latter await the operation of the will. Thus the bones which form the pelvis, although not so firmly united as those of the cranium, are, nevertheless, so closely

connected, as to afford sufficient protection to the viscera which they contain; at the same time they admit (through the medium of an intervening cartilage) some slight degree of motion, which prevents the extension of fracture, and, in the female, perhaps enables the pelvis to accommodate itself to the expulsion of the fœtus.

My attention, however, in the present work, will be principally directed to those joints which are obedient to volition and admit of free and extensive motion, as being more complicated in their structure than those which are immoveably united, and far more frequently the subject of accident and disease.

PARTS WHICH ENTER INTO THE COMPOSITION OF MOVEABLE JOINTS:

Bone, Cartilage, Synovial Membrane, and Ligament.

On each of these structures I shall only make such remarks as I deem sufficient for demonstrating their peculiar use in the formation of a moveable joint.

Bone.

Although in cutting into a joint in a healthy state *bone* is

no where exposed, yet the first great character of a moveable joint is the approximation of two or more bones, exactly fitted to each other, and firmly connected by subservient structures, which, whilst they serve to strengthen the articulation, give freedom and ease to its motions.

On Cartilage.

By the following characteristics cartilage may be distinguished from the other constituent structures of a joint; from *bone* by its elasticity, flexibility, and comparative softness; and from *ligament* by its firmer texture, elasticity, and polished surface. From the different situations in which it is found, and the different uses to which it is applied, *cartilage* may be divided into three classes. First, where it is found covering the articular surfaces of the extremities of bones, which enter into the composition of moveable joints, as on the head of the os humeri, and the glenoid cavity of the scapula. Secondly, where it is included within the synovial cavity between the articulating surfaces of bones, as in the joint between the clavicle, and first bone of the sternum, in which situations it is termed an interarticular cartilage. And thirdly, where it immediately connects bones together which are slightly capable of passive motion, as in the pubes, and sacro-iliac symphyses.

The cartilaginous structure forming the smooth surface, at

the extremity of those bones which constitute moveable joints, appears to derive its origin and formation from the constituent parts of bone itself, prior to its complete ossification. This may be observed at those early periods of life when epiphyses are found, which seem to differ from bone only in containing a smaller quantity of phosphate of lime, and in having a less fibrous appearance.

The use of cartilage is, with the assistance of synovial membrane, to prevent friction, and, by its elasticity, to facilitate motion, prevent concussion, and the extension of fracture; whilst its slight degree of vascularity, and its almost entire want of nervous sensibility, secures it from that disposition to inflammation and disease, to which, from its situation and functions, it would otherwise be so continually subjected.

Synovial Membrane.

All moveable joints contain a fluid for the purpose of lubricating their internal surface, and this is secreted by a membrane, termed *synovial*, which appears to have more of a serous than of a mucous character. Physiology supports this opinion. Like all serous membranes it is reflected, forming a cavity without any opening, and its function is the alternate secretion and absorption of its fluid. Its internal surface is smooth and lubricated, resembling the cavities of the pleura

and peritoneum. It is highly vascular, but very few nerves can be traced to it; and hence, excepting in a state of disease, it possesses but very little sensibility. In the interior of some joints, small bodies are found which have been supposed to be glandular, and were, by some anatomists, incorrectly termed the glandulæ mucilaginosæ. These are, however, merely globules of fat contained between the reflections of the membrane, from the cryptæ or folds of which, as from the rest of the cavity, the fluid is secreted. They are of a reddish colour, and assist in adapting the parts which form the joint more perfectly to each other.

When synovia is secreted in a healthy state, it is a transparent fluid of the consistence of albumen, very viscid, and, when agitated, confining a considerable quantity of air. Its use in joints is, by lubricating the cartilaginous surfaces of articulated bones, to prevent their abrasion, and facilitate their motion.

In concluding these preliminary observations, I cannot sufficiently impress on the mind of the student the necessity of deliberately and minutely examining how, by the form of the extremities of the bones constituting any particular joint, by the peculiarities of their articulatory surfaces, as distinguishable in the hinge joints, the ball and socket joints, etc., by the laxity of the synovial membrane, and the consequent proportion

of synovia secreted, the proper motions of every joint may be clearly comprehended. This knowledge will of itself prepare the student for entering with advantage on the present Treatise; for the direction being ascertained in which a joint allows the motion of bones, it must follow, that in the direction in which joints do not admit of motion, there the ligaments must be strongest and most obvious, and that the proportions of ligament, both in strength and quantity, must be adapted to the functions of the joint.

OF THE

LIGAMENTS IN GENERAL.

Ligaments are composed of firm, white, inelastic fasciculi, arranged in parallel lines, connected by cross fibres. They are formed into two distinct layers, the outer one being much more fibrous than the inner, and allowing minute blood-vessels to pass between the interstices. They differ from cartilage in being more distinctly fibrous, and from tendons in situation, and use; ligament serving to connect bone, while tendon is the medium of junction between muscle and bone. If ligament and tendon be chemically examined, their constituent parts are found to be the same.

In speaking of ligaments in particular, I shall describe those only which connect bones in the formation of joints. These

may be termed proper ligaments. Those ligamentous fibres which form sheaths, and bind down tendons in their passage over bones, would be better termed fasciæ; whilst those which are attached to soft parts, such as the liver, uterus, etc., may be distinguished by the name of connecting membrane.

The true ligaments are so intimately united to the periosteum of the bones to which they belong, that the separation can only be effected by maceration or putrefaction; they appear, indeed, to be a prolongation of the periosteum of one bone to that of another. There is, however, in many joints a line of demarcation between them; for at the point where the ligament extends from one bone to be connected with another, its interior surface is covered by synovial membrane, and at that precise boundary it is that the periosteum ceases to serve as a covering of bone, and in attaching itself to another assumes the character of ligament.

In the arrangement of the ligaments, I think it best to divide them into six classes, and place them according to their respective offices and situations, in which, however they may differ in some few particulars, they concur in their leading characteristic of connecting bones together to secure them from dislocation.

Those of the *first class* are the capsular, which form a cylindrical sac, and surround some of the moveable joints.

They are fibrous and strong in proportion to the degree of motion of the joint which they enclose. They usually receive additional strength from the tendons of the neighbouring muscles, and also from external ligamentous processes, respectively distinguished according to the relative position which they occupy with regard to the joint, as *lateral, anterior, posterior, etc.* They are closed above and below by their firm connection with the periosteum of the bones to which they are attached; their external surface is in contact with muscles and tendons, and their internal is lined by the synovial membrane. There are, however, in the formation of all the joints of the body, but two true capsular ligaments, which are those connecting the hip and the shoulder-joints.

The second class may be understood to comprehend those ligaments which are so situated as to be put upon the stretch on every motion of the bones to which they are attached. They differ in structure from other ligaments in being elastic, as in those for instance connecting the bony arches of the vertebræ, in the junction of which, no articulating surfaces are in apposition, but there merely exists this intervening ligament; after flexion of the spine this ligament, by means of its elasticity, assists in bringing the separated spinous processes again together, and thus producing an erect posture of the body.

The third class comprises those ligaments which assist in

forming the articulation between bones having but little motion upon one another; their fibres are extremely strong and short, and are in the best manner adapted to connect parts firmly together: of such ligaments are formed the sacro-iliac and pubic symphyses.

The fourth class differs from the others in being adapted more for the purpose of giving origin to muscle, than of connecting bone. In fact, in the pelvis the ligament of this class supplies the place of bone, by closing an aperture into a bony cavity, as the ligaments closing the foramina obturatoria; and the interosseus ligaments of the fore-arm and leg which give origin to muscles, constitute another example.

The fifth class comprehends those ligaments which assist in forming a surface for the reception of the articular surface of a bone, as in the ligament extending from the os calcis to the os naviculare. Its particular use is to prevent violent concussion, which must have inevitably occurred had the astragalus been received on the unyielding structure of the os calcis. It also assists in connecting more firmly together the bones of the tarsus.

The sixth class includes those ligaments which exist within joints, or more properly speaking, nearer to the centre of motion, for there are no ligaments within any synovial membrane; these give an additional security to joints, and tend

to moderate their motion. They are found in the costa vertebral, and ilio femoral articulations, and are properly termed interarticular ligaments.

Having thus finished the general definition of ligaments, I shall now proceed to describe them with respect to their relative position in particular moveable joints.

OF THE

LIGAMENTS IN PARTICULAR.

LIGAMENTS OF THE LOWER JAW.

The bones which enter into the composition of these joints, are the temporal bones, and the condyloid processes of the lower jaw. The glenoid cavities of the former receive the condyloid processes of the latter, forming that species of joint on each side which is termed *arthrodia*, viz., where the head of one bone is received into the superficial cavity of another, so as to admit of a considerable degree and variety of motion. The internal edge of the glenoid cavity is more advanced than the external. This cavity is divided into two surfaces by the fissura glasseri; the anterior alone is occupied by the condyloid process of the lower jaw; the posterior, which forms a fossa for the lodgement of the parotid gland, is termed the

fossa parotidea. It is the anterior division of this cavity that is covered with an articular cartilage, extending to the root of the zygomatic process of the temporal bone, where it terminates; the condyloid process of the inferior maxillary bone has its long diameter from side to side, and is likewise covered with a thin cartilage, which is insensibly lost on its neck: these bones are connected by ligaments which I shall now particularly describe.

The external lateral ligament, is composed of short, thin parallel fibres, which are united by a dense cellular membrane. It is attached above, by a broad origin, to the articular tubercle and outer edge of the glenoid cavity, and to the anterior edge of the meatus auditorious externus. It extends obliquely backwards, and terminates on the outer side of the neck of the lower jaw: externally, this ligament gives support to the parotid gland; and internally, it is in contact with the inter-articular cartilage, and is covered by synovial membrane.

The internal lateral ligament is composed of a number of narrow slender fibres of considerable length, which arise from the inner edge of the glenoid cavity; it passes obliquely downwards and forwards, enlarging as it descends, and is inserted into the upper and fore part of the posterior maxillary foramen: its point of insertion is a small spinous process which partly covers that foramen, and, projecting somewhat from the jaw,

leaves a space for the passage of the dental artery and nerve, which are thus protected from the action of the pterygoideus internus muscle. The precise situation of this ligament is, first between the pterygoidei muscles, and then between the pterygoideus internus, and the perpendicular plate of the lower jaw.

The stylo maxillary, or suspensory ligament. This ligament arises from the styloid process of the temporal bone, passes downwards and a little forwards, and is inserted by rather an extended surface into the angle of the lower jaw, between the fibres of the masseter and pterygoideus internus muscles. This ligament seems to be of as much importance in affording a surface for the attachment of the stylo-glossus muscle, as in connecting the temporal bone with the lower jaw.

The synovial membrane gives an internal covering to the two lateral ligaments which I have described, and is also reflected over the cartilaginous surface of the glenoid cavity in the temporal bone, and the condyloid process of the lower jaw. This membrane is divided into two synovial cavities, by the intervention of an interarticular cartilage: the upper compartment is situated between the glenoid cavity and the superior surface of the cartilage; and the lower one between the inferior surface of the cartilage and the condyloid process of the jaw. The synovial membrane is strengthened laterally

by the lateral ligaments of this joint; anteriorly by the tendon of the pterygoideus externus, and posteriorly, by the condensed cellular membrane covering the parotid gland; it is looser in this than in the anterior part.

The interarticular cartilage is composed of a thin cartilaginous layer, presenting a broad superior, and inferior surface: under the different motions of the jaw, the superior surface adapts itself to the glenoid cavity and the root of the zygomatic arch; and the inferior surface is regularly concave, to receive the condyloid process of the jaw. This cartilage is thicker behind than before, and into the posterior edge its arteries may be traced. It is bounded laterally by the two lateral ligaments, to which its edges are firmly united; above and below, it is covered by the synovial membrane; its use is to facilitate and extend the motions of the lower jaw, and partly to give insertion to the pterygoideus externus muscle.

ON THE MOTIONS OF THE LOWER JAW.

Man being an omnivorous animal, we find that the lower jaw is moveable in various directions, as the different substances on which he feeds require different actions of that part

for their complete mastication. It admits of motion downwards, upwards, forwards, and backwards, and has also lateral motion.

When the lower jaw is depressed and the mouth opened, we find the condyloid process changing its situation in the glenoid cavity; so that its upper surface is turned forwards upon the root of the zygomatic arch, the angles of the jaw are thrown backwards, and the coronoid processes are thus depressed. The interarticular cartilage is always in contact with the condyloid process. The ligaments also undergo an alteration, with respect to the states of relaxation and extension. The external ligament is rendered tense in proportion to the depression of the jaw; and the upper synovial cavity is drawn forwards, which movement its laxity posteriorly, allows; but the membrane between the inferior surface of the cartilage and the lower jaw, remains stationary, as the cartilage and condyloid process move together, in consequence of the firm attachment of the lower part of the ligament.

The stylo maxillary ligament is relaxed.

The internal lateral ligament remains in the same state.

When the jaw is elevated the condyloid process recedes into the glenoid cavity, and having arrived there, the superior surface turns upon its own axis until the teeth are brought into apposition, when the motion is completed. The position of the ligaments is changed precisely to the reverse of their

state in the former motion, viz., the external lateral ligament is relaxed, the stylo maxillary is extended, the internal lateral does not change its position, and the superior synovial membrane becomes again relaxed.

When the jaw is drawn forwards there is no motion of the hinge, but the whole jaw moves horizontally in advance, so that the condyle and the angle pass simultaneously forwards. In this motion all the ligaments are put upon the stretch, excepting the inferior part of the synovial membrane, which is kept in its relative position, with respect to the interarticular cartilage and condyloid process, by the attachment of the external pterygoid muscle, which is inserted into them both, and keeps them in situ.

The motion of the jaw backwards is but slight, in consequence of the posterior bony boundaries of the glenoid cavity; this slight retrogade motion is produced by the horizontal movements as in the last instance. The ligaments are but little altered from their natural state.

The lateral motion is produced by the condyle of the jaw being carried outwards on the one side, and inwards on the other. This motion is of limited extent, as it is soon opposed by the vaginal process of the temporal, and the spinous process of the sphenoid bone; but some advance may take place of the jaw on one side, in which case, the condyloid process on that

side passes forwards on the root of the zygomatic process, while on the other it acts in the glenoid cavity as the centre of motion; and it is by inordinate degrees of motion in this direction, that dislocation on one side sometimes occurs.

The articulation of the lower jaw also admits of circumduction, which results from the united movements backwards, lateral, and forwards.

DISLOCATION OF THE LOWER JAW.

There is but one direction in which the lower jaw can be dislocated: in this case, the condyloid process is thrown forwards and downwards, under the zygomatic arch; this displacement is produced by strong muscular action, while the jaw is in a state of complete depression. The mouth is, by the advance of the condyloid process under the zygomatic arch, mechanically kept open, so that the ligaments are much in the same state as in the natural depression of the jaw; unless from the great degree of violence which has been exercised in producing the injury, the extension be so great as to cause the laceration of the external lateral ligament, and superior synovial membrane.

I have never obtained an opportunity of examining the parts by dissection after this accident, except by producing the dislocation *post mortem*, when the muscles are found in the following state. The temporal muscle is subjected to a great degree of extension, and I should think in the living subject, in whom there would be a strong counteracting muscular power, that its posterior fibres would be frequently ruptured from the advance of the coronoid process, into which it is inserted.

The masseter muscle, in consequence of the decussation of its fibres, is with respect to its anterior and posterior edges, placed under exactly different circumstances; the anterior being relaxed, and the posterior forcibly and painfully extended. The pterygoideus internus is in a complete state of relaxation, the two bony attachments of the muscle being brought closer together. The external pterygoid muscle is also relaxed, in consequence of the condyloid process of the lower jaw being thrown nearer to the sphenoid bone, from which this muscle arises.

A perfect knowledge of the situation of muscles under dislocation, is quite essential to every medical practitioner, in order that he may be enabled to point out the best mode of reduction, by relaxing those muscles which are put upon the stretch. Nor are frequent opportunities of observing these accidents necessary for the acquisition of such knowledge,

because accurate observation of the ordinary functions of the muscles will enable the practitioner to perceive their unnatural state under dislocation. In proceeding to reduction it should be borne in mind, that the action of muscles will present the only obstacle in the case of a recent displacement. Thus in reducing the dislocation of the jaw, the object is by force to depress the condyloid process below the zygoma, and by pressing it backwards, cause the posterior fibres of the masseter and temporal muscles to draw it into the glenoid cavity. In the subsequent treatment of this case, where we have reason to suspect the laceration of muscular fibre, the jaw should be kept closed as much as possible, to afford the best chance for their perfect reunion.

Displacement of the lower jaw, as has been already observed, sometimes happens only on one side; but the mode of reduction and the ulterior treatment do not differ from those of the case in which both sides are dislocated. The difference between the two accidents is so strikingly obvious to the most cursory observer, as to render it quite unnecessary for me to make any remarks on the diagnostic symptoms.

ARTICULATIONS

OF THE VERTEBRAL COLUMN.

From the number of bones which enter into the formation of the spine, its ligaments must necessarily be numerous and complicated. They may, however, be divided into two distinct sets; viz., those which are common to all the vertebræ, and those which only appertain to particular bones of the column. I shall first proceed to describe the ligaments common to the articulations of the spine.

ARTICULATIONS COMMON TO THE VERTEBRÆ.

All the vertebræ are connected by ligaments at their *bodies*, at their *articular*, *transverse*, *spinous processes*, and also at

their *bony arches.* The articulation of the bodies of the vertebræ is effected by the common anterior and common posterior vertebral ligaments, and by an intervertebral substance.

ARTICULATION OF THE BODIES OF THE VERTEBRÆ.

The common anterior vertebral ligament originates at the lower edge of the anterior portion of the circular ligament, on the upper part of the second cervical vertebra, and extends to the sacrum, varying in breadth and thickness in its descent. It is thin and narrow on the cervical vertebræ, thicker and wider on the dorsal, and again attenuates, but is at its greatest breadth in the lumbar region. It is composed of numerous distinct longitudinal fibres, which are separated for the transmission of bloodvessels. This ligament expands itself more widely over the intervertebral substance than in its passage over the bodies of the vertebræ. Its anterior surface through the cervical region is covered by the œsophagus; on the dorsal, by the œsophagus, aorta, thoracic duct, and vena azygos; and on the lumbar by the aorta, vena cava, and the receptaculum chyli. Its posterior surface is in contact

with the vertebræ themselves, and with the crucial ligaments, and is also laterally connected with the longus colli muscle. If the common anterior ligament be raised from the intervertebral substance, small *decussating* fibres may be seen passing from the lower edge of the vertebra above, to the upper edge of the vertebra below; from which circumstance they have been termed *crucial.*

The common posterior vertebral ligament.—This ligament is usually described as arising from the lower part of the second cervical vertebra; but that portion which, by some anatomists, is called the perpendicular ligament of the dentiform process, is in fact the commencement of the common posterior vertebral. It takes origin, therefore, from the upper and fore part of the foramen magnum, and the concavity of the basilary process of the occipital bone, descending from thence within the vertebral canal on the posterior surface of the bodies of the vertebræ, to the sacrum. It first passes behind the odontoid process, and extends laterally in its passage over the posterior surface of the intervertebral substance. None but minute vessels can be traced to it, nor is its structure so fibrous as that of the common anterior ligament. In the cervical and dorsal regions it is thicker than in the lumbar. The posterior surface of this ligament is in contact with the dura mater, covering the spinal marrow; the anterior is

attached to the bodies of the vertebræ and to the intervertebral substance, and is very firmly connected with the latter. Its lateral edges are parallel to the sinus venosus. This ligament prevents the spine from being bent too much forward.

The intervertebral substance.—The structure of this substance partakes of the nature of ligament and cartilage; it occupies the spaces between the bodies of the vertebræ, corresponds in shape with the bodies of those which it connects, and like them differs in the different regions, gradually increasing in density, and separating the vertebræ more widely as it approaches the sacrum. It is composed of oblique concentric lamellæ, which are stronger in the external circumference than in the centre, where it is almost fluid; it has, therefore, so little compressibility, as to allow the free motions of the vertebræ upon one another, as if they moved upon a pivot, and at the same time diminishes concussion under the violent motions of the spine; it is closely attached at its edge to the bodies of the vertebræ, and is so elastic, that man loses somewhat of his height towards evening, from the pressure to which this substance is subjected by an erect posture during the day. Its strength is such, its attachment so perfect, and its resistance so great, that it will allow even bone to give way rather than yield itself. Its anterior surface is in contact with the common anterior vertebral ligament; laterally, with

the interarticular ligament of the ribs; and posteriorly, with the common posterior vertebral ligament.

ARTICULATIONS OF THE ARCHES OF THE VERTEBRÆ.

The bony arches of the vertebræ are connected by means of a very elastic yellowish ligamento-cartilaginous structure, which fills up the spaces between them, but allows of extensive motion between one arch and another. The first of these ligaments is found between the second and third cervical vertebræ, and the last between the fifth lumbar and the first bone of the sacrum. It is divided into a right and left portion by some intervening cellular membrane, but united at an angle posteriorly near the base of the spinous processes. In the fœtus this ligament is separated into two distinct portions, which probably do not unite until the ossification of the spinous processes has been perfected. It differs from all other ligaments in being extremely elastic, and capable of resisting an extraordinary degree of force. Its anterior face is in contact with the dura mater of the medulla spinalis; posteriorly it is of a reddish tint, and is with difficulty perceived without

producing flexion of the spine, in consequence of its being so much covered by the arches of the vertebræ, particularly in the dorsal region.

ARTICULATION OF THE ARTICULAR PROCESSES.

The faces of the articular processes are covered with cartilage, and are connected by synovial membrane, which forms a very small capsule, and secretes but an inconsiderable quantity of synovia. On the exterior there are some irregular ligamentous fibres which connect the processes more firmly together, and are more visible on the dorsal and lumbar, than on the cervical vertebræ. Their inner edges are connected with the ligamentum subflavum.

LIGAMENTS WHICH APPERTAIN TO PECULIAR ARTICULATIONS OF THE VERTEBRÆ.

The ligaments which appertain to peculiar articulations of the vertebræ are, first, those which connect the atlas with the

occiput. The condyloid processes of the occiput are received into the articular surfaces of the atlas; both of which are covered with cartilage and synovial membrane, and are connected by ligaments which retain them firmly in their situation.

The anterior portion of the circular ligament is attached above to the fore part of the foramen magnum, and extends itself to the sides of the condyloid processes; it thence passes down and is inserted into the fore part of the arch of the atlas, and into the edges of the articular surfaces of that bone.

Posterior portion of the circular ligament.—This ligament is much larger than the anterior; it arises from the posterior margin of the foramen magnum, extending itself laterally as far as the capsular ligament, connecting the occiput with the atlas, and then passes down to be inserted into the upper part of the posterior arch of the atlas. This ligament has in contact with its posterior surface, the straight and superior oblique muscles of the head, the vertebral arteries, and sub-occipital nerves.

The synovial membrane covers the occipital condyles and articular processes of the atlas, lining at the same time that part of the internal surfaces of the anterior and posterior circular ligaments, which are in contact with those portions of bone, and thus forming capsular processes for the more perfect security of this articulation. The synovial membrane is also

attached on its inner side to the transverse ligament of the atlas.

LIGAMENTS CONNECTING THE VERTEBRA DENTATA WITH THE OCCIPUT.

These bones are not in actual contact so as to form a joint, but they are kept in their relative situation by the *two lateral* or *alar ligaments,* which arise connected with each other from the body and sides of the odontoid process, reaching as far as its apex; from which point they pass on either side upwards and outwards, to be inserted between the inner edge of the condyloid processes and the foramen magnum of the occipital bone.

LIGAMENTS PROPER TO THE ATLAS.

The ligaments which form the articulation between the atlas and the second cervical vertebra, or the vertebra dentata, are *first,* the transverse ligament, which is proper to the atlas; and *secondly,* the ligaments of the articular processes, which are common to all the vertebræ.

The transverse ligament arises from a rough tubercle on the inner side of the articular process of the atlas; then forming an arch which encloses the odontoid process of the second cervical vertebra, it passes forward to be inserted into the inner side of the opposite articular process. The middle fibres which are in contact with the dentiform process, are the strongest; and from this part two appendices issue, a superior and an inferior; the superior passing along the odontoid process, is lost just above its apex in the fibres of the common posterior ligament of the vertebræ; the inferior appendix arises from the inferior edge of the transverse ligament, passes downward in connection with the lower part of the odontoid process, and is also imperceptibly lost amid the fibres of the common posterior vertebral ligament. The transverse ligament, together with the appendices, forms a cross, between the anterior part of which and the odontoid process, is a synovial membrane, which is sufficiently loose to allow of free lateral motion between the first and second cervical vertebræ. There is also a synovial membrane covering the cartilaginous surfaces, upon the fore part of the odontoid process and arch of the atlas. This ligament is an instance of tho e arranged under the fifth class, mentioned in the introductory remarks.

CERVICAL LIGAMENT.

The cervical ligament arises from the perpendicular spine of the occiput, and is inserted into the spinous process of the five superior cervical vertebræ. It is much stronger in quadrupeds than in man, as from their horizontal posture, such a structure is essentially necessary to support the weight of the head. In man it appears to be of little more use than to give attachment to muscles, although it may, in some degree, assist in maintaining the proper position of the head in the erect posture.

Interspinous ligaments.—These ligaments extend from the apex of one spinous process to that of another, and are situated immediately under the skin. They commence at the sixth cervical vertebra, and extend as far as the sacrum. Laterally they intermix with the tendinous origin of the trapezius and latissimus dorsi muscles. These ligaments are sometimes described as occupying a considerable portion of the bodies as well as the apices of the spinous processes; but it appears that the structure in that situation is merely the tendinous origin of muscle.

In the dorsal vertebræ there are some fibres of ligamentous appearance, situated between the transverse processes, which have been called *intertransverse* ligaments, but which do not

deserve such a classification, as they seem rather to be the origin of the levatores costarum and multifidæ spinæ than proper ligaments.

MOTIONS OF THE SPINE.

With respect to this function of the spine, there are three ways in which it may be considered. *First,* its general mobility as a whole; *secondly,* the peculiar motions of each region; and *thirdly,* the mobility which exists between any two particular vertebræ.

The general motions of the vertebral column are those of *flexion, extension, lateral inclination, circumduction,* and *rotation.* The most extensive motion of which the spine is capable, is *flexion;* for although the degree of motion between any two vertebræ is extremely limited, still as that motion is multiplied by the number of vertebræ, the flexibility of the whole column becomes very considerable. The lower extremities being fixed, the abdominal muscles draw the ribs forwards and downwards, and the whole trunk is bent, so as to form a parabolic curve. In this action the common anterior ligament is relaxed, the fore part of the intervertebral

substances is compressed, while their posterior edges are stretched; and the common posterior ligament of the vertebræ, together with the interspinous ligaments, are in a state of extension.

In *extension* the ligaments are placed precisely in the reverse state to that which they assumed in flexion, those which were extended being in their turn relaxed, while the common anterior vertebral is now put upon the stretch: this motion is more confined than that of flexion, in consequence of the spinous processes of the dorsal vertebræ being soon brought into apposition, in which state no farther extension is possible.

In the *lateral inclination*, the intervertebral substances are compressed on that side to which the body is bent; the other ligaments are scarcely altered from their natural state, as the motion, being restricted by the resistance which is offered by the ribs, and the transverse processes of the vertebræ, is too inconsiderable to affect them.

Circumduction is produced by the succession of the other motions, so that the ligaments undergo the changes peculiar to each motion, as rapidly as it occurs.

The *rotatory* motion of the spine is very limited in all the vertebræ, but more particularly in the dorsal, in consequence of their attachment to the ribs. In this motion the intervertebral substance is contorted, as are likewise all the ligaments.

All the motions of the spine are capable of being aided to a great extent, by the motion of the pelvis upon the thighs.

MOTIONS PECULIAR TO EACH REGION.

The extent of motion in the several regions of the spine, is in proportion to the thickness of the intervertebral substance; it is, therefore, much greater and more extensive in the cervical and lumbar regions than in the dorsal, in which it is not only impeded by the comparative tenuity of this substance, but also by the oblique directions of the spinous processes of these vertebræ, and their attachment to the ribs.

MOTIONS BETWEEN PARTICULAR VERTEBRÆ.

The free motion of one vertebra on another is particularly exemplified in the first and second cervical. The occiput being articulated with the atlas, flexion, extension, and, in a slight degree, lateral motion, are allowed between them; but if there be necessity for these motions to any extent, the whole

of the cervical vertebræ participate in them. It is, however, in the rotatory motion of the head, that the first and second cervical vertebræ act upon one another, and the species of articulation formed by these two bones shews how well they are calculated for that purpose, and how essential they are in the performance of most of the animal functions: they increase and regulate the powers of *vision, smell* and *hearing*, and by shortening and prolonging the trachea, alter the tones of the voice. Even the intentions of the mind are dictated by the voluntary action of the muscles moving the head: *consent* is acknowledged by a nod, whilst lateral motion expresses a *refusal.*

DISLOCATION OF THE VERTEBRÆ.

The number and breadth of the attachments of these bones,—their firm union by ligament,—the strength of their muscles,—the very inconsiderable degree of motion which exists between any two of them,—and lastly, the obliquity of their articular processes, especially in the dorsal and lumbar vertebræ, render dislocation of them, at least in those regions, impossible without fracture; and I much doubt whether dislocation even of the cervical vertebræ ever occurs without

fracture, either through their bodies or their articular processes: the effects of each of these accidents would produce precisely the same injury to the spinal marrow, and symptoms of greater or less importance, according to the part of the spinal column that is injured. Death is the immediate consequence if the injury be above the third cervical vertebra, the necessary paralysis of the parts to which the phrenic and intercostal nerves are distributed, causing respiration instantly to cease. If the injury be sustained below the fourth cervical vertebra, the diaphragm is still capable of action, and dissolution is protracted; the symptoms, in fact, are less violent in proportion as the injury to the spinal marrow is farther removed from the brain; but death is the inevitable consequence, and that in every case at no very distant period.

For a further description of these accidents to the spine, I must beg leave to refer my readers to Sir Astley Cooper's work on Dislocations and Fractures of the Joints, in which they are detailed so minutely, that any observations of mine on their nature or treatment would be extraneous to the direct object of the present treatise.

LIGAMENTS OF THE RIBS.

In the osteological description of the dorsal vertebræ, all excepting the first, tenth, eleventh, and twelfth, are said to have an half articular surface on their bodies, above and below, for the head of a rib, which has two corresponding half articular surfaces, each covered by cartilage. They are surrounded by a synovial membrane; and the following particular ligaments connect them firmly to the vertebræ.

Anterior ligament of the head of the rib.—This ligament surrounds the anterior part of the head of the rib, and then, in all excepting the first, eleventh, and twelfth, divides itself into three orders of fasciculi, one passing upward to the articulation of the rib with the vertebra above, another passing to the vertebra below, and the third and central fasciculus attaching the rib to the intervertebral substance; thus every rib is firmly

attached to two of the vertebræ, and to the intervertebral substance. The anterior face of this ligament is covered by the thoracic ganglia of the sympathetic nerve, by the pleura, and on the right side by the vena azygos ; and posteriorly it is in contact with the synovial membrane of the articulation of the ribs with the vertebræ, for which it forms a capsule.

The interarticular ligament enters into the articulation of all the ribs, from the second to the tenth inclusive, and is apparent on raising the middle fasciculus of the former ligament. It arises from a small tubercle situated between the two articular surfaces on the head of the rib, and passes to be attached to the intervertebral substance.

The synovial membrane is reflected upon the half of the articular surface of the rib and vertebra, both above and below, forming two distinct bags, which are separated by the interarticular ligament. Their synovial secretion is very limited.

The articulation of the tubercle of the rib with the transverse process of the dorsal vertebræ, exists in all the ribs excepting the eleventh and twelfth, and is formed by the contact of these two parts, both of which are covered with cartilage. They are furnished with a small synovial cavity, which secretes more synovia than the preceding articulation. The following ligaments concur in fortifying this joint.

The external transverse ligament arises from the apex of the transverse process of each dorsal vertebra, and passes outwards to be inserted into the neck, reaching as far as the angle of each rib. These ligaments gradually increase in size as far as the ninth rib, which is the longest from its tubercle to its angle, and is composed of fasciculi of great strength; with regard to the twelfth rib, the ligament passes obliquely downwards to be inserted into its body, serving by this attachment to connect it with the transverse process of the vertebra, indeed they are connected solely by this medium, having no articulatory surfaces in contact.

The use of this ligament is to prevent the rib from being thrust forcibly forwards from the transverse processes of the vertebræ.

The external ligament of the neck of the rib arises from the external surface of the inferior articular process of the vertebra above, and from the root of the transverse process; between these two origins is a space for the passage of some posterior nerves from the intercostals; it then passes downwards to be inserted into the upper part of the neck of the rib below. It prevents the neck of the rib from being elevated by the action of the intercostal muscles, but allows the head to turn in its capsule, so as to admit of the elevation of the body of the rib in inspiration.

The internal ligament of the neck of the rib arises from the anterior surface of the transverse process of the next superior vertebra, and passes downwards to be inserted into the fore part of the neck of the rib immediately below; it is attached, therefore, in a very similar manner to that of the external ligament of the neck of the rib, except that it is situated anteriorly, and its fibres pass somewhat more inwards, so as to decussate with those of the external ligament.

Articulation of the body of the rib to its cartilage.—There are some anterior and posterior ligamentous fibres, which pass from the bodies of all the ribs to their respective cartilages, and connect them firmly together. The cartilages of the seven superior ribs pass forwards to be attached to the sternum, with which they are connected by an anterior and posterior ligament, and synovial membrane.

The anterior ligament is fixed to the extremity of the cartilage; it then passes, with its fibres diverging, to be fixed to the anterior part of the sternum, upon which it spreads itself, and interlaces with those of the opposite side, and with the periosteum, as well as with the anterior ligament of the cartilage of the rib above and below it, so as to form a complete ligamentous covering to the sternum. This decussation of the fibres is more particularly obvious at the union of the sixth

and seventh cartilaginous articulations with the sternum, than at any other part.

The posterior ligament is not so thick as the anterior, but is attached, like it, to the cartilages of the ribs, and to the sternum; while on its posterior surface it diverges and interlaces with the ligaments above and below, and with the periosteum, forming a complete posterior covering to the sternum.

The synovial membrane which covers the articular surface of the cartilage of the rib and of the sternum, is extremely small; and were it not for the occasional occurrence of an inordinate secretion of synovia, the result of inflammation, its existence might almost be doubted. The seventh rib being attached to the cartilago ensiformis, its ligament is sometimes called the *ligamentum ensiforme.*

Articulation of the false ribs.—These bones are all connected together by their cartilages excepting the *last*, which is only attached by muscle. Their union appears to be produced by anterior and posterior ligamentous fibres, similar to those which connect the true ribs to the sternum, but they are not so strong.

Ligamentum arcuatum, arises from the apices of the transverse processes of the two upper lumbar vertebræ, and passes upwards and outwards to be attached to the acute edge of the last rib throughout its whole extent.

LIGAMENTS OF THE STERNUM.

Besides the ligaments which have been described as passing from the cartilages of the ribs to the sternum, there are proper ligaments connecting the three bones of the sternum, and running principally in a longitudinal direction.

From the numerous ligaments which connect the ribs to the vertebræ, and the improbability that sufficient force should ever be applied to one rib to produce dislocation, it is an accident that seldom occurs. Should it happen, however, that the head of a rib were detached from the vertebræ by any violence, the same symptoms would present themselves as in cases of fracture, and would require the same mode of treatment.

For my own part, I do not believe in the possibility of dislocation of the rib from the vertebræ, unless there has been some prior disease, which has partly destroyed its ligamentous

connexions; on the contrary, I am disposed to conclude, that a rib sustaining such a degree of violence as might be supposed capable of dislocating it, would be invariably fractured at its neck. Such I find to be the case in experiments upon the dead body, where though the rib be subjected to the application of force by means of an instrument best calculated to detach its head from the articulation, yet it is always broken. The cartilages are sometimes separated from the bodies of the ribs, and from the sternum; but this is more frequently the result of distortion of the spine, and consequent gradual displacement, than of any sudden violence, which might, however, forcibly separate them.

ARTICULATION

OF THE

SUPERIOR EXTREMITY.

The shoulder is united by means of the clavicle with the sternum, through the medium of an interarticular cartilage, but the scapula is only connected with the trunk by muscle; and the sterno-clavicular articulation forms the fulcrum for all the motions of this part.

ARTICULATION OF THE CLAVICLE TO THE STERNUM.

The sternal extremity of the clavicle is concave, and is placed rather above the articular surface of the sternum; these two surfaces are covered by cartilage. This articulation

is constituted by four ligaments; an *anterior, posterior,* an *interclavicular,* and a *costo clavicular,* or rhomboid; and by an interarticular cartilage.

The anterior ligament is composed of strong fibres, which run in parallel lines from the upper extremity of the clavicle to the anterior face of the first bone of the sternum: there its fibres diverge and mix with the ligaments connecting the first rib, and assist in forming the anterior ligamentous sheath of the sternum. Its posterior face is united firmly to the interarticular cartilage, and to the synovial membrane; its anterior corresponds to the origin of the sterno-cleido mastoideus muscle, and the integuments.

The posterior ligament is neither so large nor so strong as the anterior; it is united above to the posterior part of the internal surface of the clavicle, and below to the superior and posterior surface of the sternum, being firmly attached to the edge of the articular surface. The anterior portion of this ligament is in contact with the interarticular cartilage and the synovial membrane; the posterior covers the sterno-hyoideus and thyroideus muscles.

The interclavicular ligament.—This ligament is strong, and is composed of parallel fibres which run transversely from the head of one clavicle to the head of the other, above the concave semilunar edge of the sternum. It is sometimes

composed of two fasciculi, an upper and a lower, but usually only of one. It is connected on the heads of the clavicles with the sterno-clavicular articulations, and from its lower edge, as it passes above the upper part of the sternum, it is attached to its periosteum by cellular membrane. The use of this ligament is not only to connect the clavicles firmly with each other, but also to strengthen their articulation with the sternum. It also assists in protecting the trachea, as it passes through the upper opening of the chest.

The rhomboid ligament is connected firmly with the inferior surface of the clavicle, and with a small tubercle close to its sternal extremity. It is strong and broad, and passes obliquely downwards and forwards to be inserted into the anterior part of the cartilage of the first rib, close to its junction with the sternum, and mixes with the ligament which connects them. The use of this ligament is principally to fix the clavicle for the action of the sterno cleido mastoideus, and to give attachment to the subclavius muscle.

The interarticular cartilage.—This cartilage is very nearly circular, having a smooth surface above for its attachment to the clavicle, and one below for the sternum. It is thick and rough at its circumference, and comparatively thin in its centre. It adjusts itself to the articular surfaces of both the clavicle and sternum, extending as far on the latter bone as

the attachment of the cartilage of the first rib, with which it is firmly connected. This cartilage is in the form of a wedge with its base turned upwards to the clavicle, and its apex descending obliquely to be connected with the first rib. In structure it resembles the interarticular cartilage of the lower jaw; its fibres being more apparent at the circumference than at the centre.

Synovial membrane.—This membrane is separated, as in the instance of every joint where there is an interarticular cartilage, into two synovial cavities; the upper one belonging to the articular surface of the clavicle, and the superior face of the interarticular cartilage; the lower one being between the sternum and the cartilage. They are reflected over the internal surfaces of the anterior and posterior sterno-clavicular ligaments. They secrete but an inconsiderable quantity of synovia, and sometimes the two cavities are united by an opening through the cartilage.

The upper synovial or clavicular capsule admits of motion upwards and downwards, while the lower or sternal capsule admits of backward and forward motion; and, therefore, we find in this as in all other joints where there is an interarticular cartilage, that strength is added to the capsular ligament without limiting its motions.

LIGAMENTS OF THE SCAPULAR EXTREMITY OF THE CLAVICLE.

This articulation is strengthened by the following ligaments, which may be divided into those which attach the clavicle to the acromion, and those which connect it with the coracoid process of the scapula. This latter junction is produced by ligament only, there being no bony continuity; while in the former the surfaces of bone are in juxtaposition, presenting superior and inferior surfaces which give attachment to corresponding ligaments.

SUPERIOR LIGAMENT, OR ACROMIO CLAVICULAR UNION.

The superior ligament is composed of very strong fasciculi, which pass from the upper surface of the clavicle to the

extremity of the acromion, and expose a surface for the tendinous insertion of the trapezius and for the origin of the deltoid muscles, from which they are sufficiently distinct.

The inferior ligament.—This ligament, anteriorly, is in contact with the preceding; it then passes on the under surfaces of the clavicle and acromion, but does not extend so far backwards as to be connected with the posterior edge of the superior ligament; its inferior surface is in contact with the infra spinatus muscle, while its superior surface is connected with the synovial membrane of this articulation. It is so loose as to allow of some degree of motion independently of the scapula.

Synovial membrane covers the articular surfaces of both bones, but secretes very little synovia; it is sometimes divided into two cavities by an interarticular cartilage; this, however, is but of rare occurrence.

JUNCTION BETWEEN THE CLAVICLE AND CORACOID PROCESS OF THE SCAPULA, OR CORACO CLAVICULAR UNION.

This union is formed by two ligaments which connect the clavicle with the coracoid process. They arise by a single

origin from the coracoid process, but separate into two portions to be inserted into the clavicle, which admits of their being described as two distinct ligaments, the conoid and the trapezoid.

The conoid is the posterior and interior of the two; it is of a conical form, with its base upwards, which is attached to the tubercle at the under part of the clavicle, its apex being connected with the coracoid process.

The trapezoid is anterior and external; it is broader than the conoid ligament, but not so strong; it extends from the middle of the convexity of the coracoid process, passes upwards and outwards, and is attached to the under surface of the scapular extremity of the clavicle close to the connection of this bone with the acromion. The connection of these ligaments is strong; but at the same time they are sufficiently loose to admit of the scapula performing several of its motions without the clavicle, which may on this account remain stationary: they also serve, under very violent exercise, or in case of a blow, to prevent an immoderate depression of the scapula; for their strength is such, as to resist violence even to that degree which causes the fracture of the clavicle.

LIGAMENTS PROPER TO THE SCAPULA.

There are two ligaments proper to the scapula, the anterior or acromio coracoid, and the posterior or coracoid.

The anterior or acromio coracoid ligament is triangular; it arises by its base from the outer side of the coracoid process, and is inserted by its apex into the inner side of the acromion. It is attached to the whole length of the external edge of the coracoid process, from which it sometimes passes in two fasciculi to the posterior edge of the acromion; but the space between the two is filled up by condensed cellular membrane. The anterior edge of this ligament gives off a strong fascia, which is attached to the under part of the deltoid muscle, and to the tendons of the supra and infra spinati. Its superior surface is covered by the clavicle and deltoid muscle; the inferior surface covers the supra spinatus. This ligament, passing from the acromion to the coracoid process, forms an arch over the head of the os humeri, which is usually said to assist in preventing dislocation of the os humeri upwards. This dislocation, however, is rendered impossible by the proximity of the acromion and coracoid processes, unless one or other of these processes be fractured; so that this ligament seems rather useful in extending the surface for the origin of muscle, than in preventing dislocation.

The posterior or coracoid ligament.—This ligament arises from the superior costa of the scapula, passes over the semilunar notch, which it forms into a foramen, and is attached to the root of the coracoid process; it is broader posteriorly than anteriorly. It gives origin in part to the omo hyoideus muscle, and covers the supra scapular nerve, which thus passes through the foramen, while above it the supra scapular artery takes its course.

MOTIONS OF THE CLAVICLE.

I am now to describe the numerous and different motions of which the clavicle is capable, and from which it might *a priori* be supposed, that this bone would be very frequently liable to dislocation; in consequence, however, of the many strong ligaments which connect it at its sternal and scapular extremities, its luxation happens less frequently in proportion to its motions, than that of any other bone in the body.

The motions of the clavicle are dependant upon those of the scapula, which is capable of being moved upwards, downwards, forwards, and backwards; and from the combination of all these movements, it likewise admits of circumduction.

Although the scapular extremity of the clavicle receives the

first impulse from muscular power, still it is at the sternal extremity that the ligaments sustain the greatest change under these various motions.

First, upwards.—When the shoulder is raised by the elevation of the scapula, the sternal extremity of the clavicle is thrust deeply into its articular cavity, and thus its interarticular cartilage is brought nearer to the surfaces of the clavicle and sternum; the rhomboid or costo-clavicular ligament being put upon the stretch, prevents luxation and further motion; while the interclavicular, anterior and posterior ligaments are relaxed.

Secondly, downwards.—In this motion the ligaments are precisely in an opposite state to the preceding.

Thirdly, forwards.—It is in this motion that the clavicle is most liable to be luxated backwards at its sternal extremity; but in consequence of the strength of the posterior and interclavicular ligaments, which are put upon the stretch, this accident is prevented; the anterior ligament is necessarily relaxed, but the rhomboid or costo-clavicular ligament remains in its natural state.

Fourthly, backwards.—In this motion the scapular extremity of the clavicle is drawn backwards, while its sternal extremity is thrust forward, and stretches the anterior sterno-clavicular ligament. If at this moment the shoulder were violently thrust

still farther backward, the sternal extremity of the clavicle might be dislocated forward; but the rarity of this accident is dependant upon the strength of the interclavicular and posterior ligaments, which are put upon the stretch.

Lastly.—With respect to circumduction, it is a quick succession of all these motions; during which, the ligaments adapt themselves with rapidity to their alternate states of relaxation and extension.

With respect to the dislocations and mode of reduction of this bone, I think I cannot do better than again refer my readers to Sir Astley Cooper's work on this subject; and I trust I shall not be accused of partiality if I recommend it as containing the result of mature reflection, and long and extensive experience.

LIGAMENTS

OF THE

SHOULDER-JOINT.

The bones which enter into the composition of this joint are the scapula and the humerus; the head of the latter being received into the glenoid cavity of the former, and there retained in its situation by ligaments. On examining the glenoid cavity of the scapula in the recent state, we find it rendered deeper by a fibro cartilaginous substance, which surrounds its edge, and is attached to the tendon of the long head of the biceps muscle; this is called the *glenoid ligament;* it assists in retaining the head of the humerus in its situation, and also gives extent of surface for the attachment of the synovial membrane.

Before I enter upon a description of the ligaments, I would direct the attention of the student to the peculiar construction

of this joint, which excels all others of the body by its extent and variety of motion. This superiority arises in a considerable degree from the action of the numerous muscles attached to the scapula, which is thus endowed with a mobility peculiar to itself. It is also owing to the form of the articulatory surfaces of that bone and the os humeri, which are most effectually adapted to the above purposes; the ligaments also are sufficiently loose to allow full play to the bones while under the influence of the muscles; which combined circumstances render this joint so particularly liable to dislocation. Thus we find that anatomy, physiology, and even pathology, all tend to illustrate the different functions of this joint.

Capsular ligament.—This ligament envelops the joint. It arises from the neck of the scapula, and adheres to the glenoid ligament over which it passes, then expands itself to surround the head of the os humeri, and contracts again as it extends downwards to be inserted into the neck of the humerus, reaching as far as the tubercles of this bone, where it is inseparably connected with the tendinous insertions of the teres minor, spinati and subscapularis muscles. This capsule, where it extends from the greater to the smaller tubercle of the humerus, leaves a foramen for the passage of the tendon of the long head of the biceps muscle.

The capsular ligament is not of an uniform thickness, being

thinnest on its outer and hinder part; but here it is strengthened by the tendons of the teres minor and infra spinatus muscles. On the inner side towards the axilla, where there is no tendinous expansion to give it support, it is found sufficiently strong and unyielding to prevent the displacement of the head of the humerus in that direction by any ordinary force. Besides the support which this ligament receives from the tendons of muscles, it derives additional strength from strong fasciæ, which extend from the different processes of the scapula, and is especially fortified by a fascia from the anterior part of the triangular or coraco acromial ligament, which is situated immediately underneath the belly of the deltoid muscle. We find that the capsular ligament of this joint is more lax than is necessary for the mere junction of the two bones which it connects, in order to allow the free and various motions of which the shoulder-joint (constituted, as its form shews, rather for mobility than strength), is so capable.

This ligament, then, appears to be of more service in giving attachment to the synovial membrane, which completely lines it, than in preventing the dislocation of the head of the os humeri. Of the four muscles which are inserted into the capsular ligament, the tendon of the subscapularis is most completely blended with it, so that it is not practicable to separate them without laceration. This tendon seems even to

pierce the capsule, in order to gain its insertion into the smaller tubercle of the humerus.

Synovial membrane.—This membrane lines the glenoid cavity, passes over the glenoid ligament, to which it is attached upon its internal and external surfaces, then extends as far back upon the neck of the scapula as the origin of the capsular ligament, which it completely lines, then passes partly under the tendinous insertions of the spinati muscles, then covers the cartilaginous head of the os humeri, prolongs itself into the bicipital groove, forming a *cul de sac,* so as to prevent the escape of synovia by enveloping the tendon of the biceps, then extends itself by passing inwards to give a lining to the insertion of the subscapularis muscle. Thus it retains the characteristic of all synovial membranes, forming a complete cavity without an external opening. The use of this membrane is to secrete synovia for lubricating the joint; and this secretion being always proportioned to the mobility of the articulation, the quantity in this instance is very considerable.

DISLOCATION OF THE OS HUMERI.

I SHALL now proceed to describe the dislocations to which the os humeri is liable, and distinguish the different states of the capsular ligament, and of the muscles which are inserted into it, under each particular form of displacement. I do not hesitate to do this, although Sir Astley Cooper has entered upon the same subject, because he has treated rather of particular cases and their dissections; whilst it is my wish, in pointing out the necessary effects of each particular accident, to refer to general principles.

All the muscles which arise from the scapula and are inserted into the os humeri, must be more or less affected in every displacement of this bone, which may be luxated in four directions; three in which the head of the bone is completely

thrown from the glenoid cavity, and one where it rests upon its edge against the outer side of the coracoid process of the scapula.

First, downwards and inwards into the axilla, which is the most common direction of displacement. In this accident all those muscles which arise from the upper part of the scapula and are inserted into the os humeri, must be more or less put upon the stretch, as the points of attachment of these muscles are rendered more distant from one another. It is clear, therefore, that the two spinati, the subscapularis, the coraco brachialis, and the teres minor, must be extended; more particularly the subscapularis, not merely from the separation of its two points of attachment, but also from the pressure of the head of the os humeri, which is frequently so great as to cause the laceration of that muscle. The elbow, in this accident, being removed to a considerable distance from the side, the teres major, with the posterior fibres of the deltoid muscle, are relaxed; while the anterior fibres of the latter muscle are extended. The pectoralis major and the latissimus dorsi are but slightly affected, but are still to be kept in view with regard to the reduction of the bone, as they would otherwise form a very considerable opposing force.

In this accident the capsular ligament is torn through on the inner side of the glenoid cavity near the insertion of the

subscapularis, so as to allow the head of the humerus to pass through it into the axilla.

Secondly, dislocation forwards under the pectoral muscle.—The spinati and subscapularis muscles are put upon the stretch, much to the same extent as in the last dislocation; the teretes are somewhat extended, the pectoralis major is relaxed, while the latissimus dorsi is put upon the stretch. The capsular ligament is torn through as in the last described accident.

Thirdly, dislocation backwards or upon the dorsum scapulæ.—In this accident the subscapularis must be necessarily torn through. The spinati, with the teres major, are relaxed, while the teres minor remains much in its natural state as to its degree of extension, although its direction be somewhat changed. The deltoid and coraco brachialis muscles are relaxed, while the pectoralis major and latissimus dorsi are in a state of extension. The capsular ligament is torn through.

Fourthly, partial dislocation forwards where the head of the bone rests on the edge of the glenoid cavity.—Here the subscapularis is found but little altered from its natural state. The spinati muscles are slightly extended. The anterior fibres of the deltoid are relaxed, while its posterior fibres are stretched. The teretes are extended, and the pectoralis major is relaxed, excepting a few of its inferior fibres, while the latissimus dorsi is put upon the stretch. It is not indispen-

sable to the occurrence of this accident that the capsular ligament should be torn through. With respect to the modes of reduction mere mechanical rules will be of little avail, unless the surgeon possess sufficient experience to warrant him in exercising his own discretion in the means to be applied for the purpose, which must vary according to circumstances in every particular case. The following, however, may be considered as general points to be attended to; the means of fixing the socket for the reception of the displaced head of the bone; the relaxation of the muscles, the unnatural tension of which constitutes the principal opposing force; the direction in which the extension is to be made; and the best mechanical mode of applying the extending power.

LIGAMENTS OF THE ELBOW-JOINT.

This joint is composed of the condyles of the humerus above, and of the heads of the radius and ulna below; the rounded extremities of the former being received into corresponding cavities in the two latter, the surfaces of which are completely covered with cartilage. This union forms a complete hinge-joint; but the radius also enjoys rotatory motion, which produces pronation and supination of the hand: this is effected by the head of the radius receiving but a small rounded portion of the external condyle of the humerus above, while the inner half of the circumference of its head is received into the lesser sigmoid cavity of the ulna, both these portions being covered with cartilage. This mode of articulation allows the radius to turn upon its own axis.

Four ligaments concur in the formation of this joint, which are all lined by synovial membrane, viz., an *anterior*, a *posterior*, and an *external* and *internal lateral ligament.*

The anterior ligament, arises from the lower part of the humerus, between the two condyles immediately above the cavity which receives the coronoid process of the ulna in flexion; it also reaches laterally as far as the edges of the condyles, over which it passes downwards to be inserted into the coronary ligament of the radius and root of the coronoid process of the ulna; its fibres pass in different directions, those from the internal condyle with considerable obliquity to be attached to the coronary ligament of the radius, while the middle and external fibres pass vertically downwards.

The posterior ligament, arises from the upper part of the cavity in the humerus which receives the olecranon of the ulna in extension; it passes laterally on the sides of the condyles where it meets with the anterior ligament, and also with the upper edges of the internal and external lateral ligaments; it is loosely connected with the olecranon, and is inserted into the lower and posterior part of the os humeri, between the two condyles. This ligament is entirely exposed only when the fore arm is flexed upon the upper. Its posterior surface is covered by the tendon of the triceps, while its anterior is in

contact with the synovial membrane, which lines both this and the anterior ligament.

The external lateral ligament.—This ligament is so intimately connected with the tendons of those muscles which arise from the external condyle of the os humeri, as to be with difficulty separated, and does indeed seem to have a common origin with the supinator radii brevis; it is of a triangular shape, its apex being situated above and its base below; it arises from the lower part of the external condyle, becomes broader as it descends, passes over the articulation, then spreads itself so as to surround the head of the radius, and is inserted into the anterior and posterior edges of the smaller sigmoid cavity of the ulna in common with the coronary ligament which it covers. Thus it is clear that the rotatory motion of the radius is not confined by this ligament, as it is inserted only into the ulna and coronary ligament, and is entirely unconnected with the radius itself.

The internal lateral ligament.—This ligament is of the same shape as the preceding, being triangular; but is more distinctly marked by the direction of its fibres, which is anterior and posterior. It arises from the internal condyle; the anterior fibres passing from it to the coronoid process of the ulna, are covered by the flexors of the wrist and fingers, and

are in contact with the synovial membrane; its posterior fibres have the same origin, diverge from the former, and pass backwards to be inserted into the inner side of the olecranon; they also give attachment to the synovial membrane, and protection to the ulnar nerve. The insertions of this ligament are connected by some ligamentous fibres which are attached to the olecranon and coronoid process, and, by some anatomists, have been described as a separate ligament.

Before I give an account of the synovial membrane of the elbow-joint, I shall describe the radio-ulnar articulation, with its coronary ligament, as that membrane is common to each.

On the outer side of the ulna there is an articular surface which is called the smaller sigmoid cavity, and receives the head of the radius. This articulation is completed by the coronary ligament.

The coronary ligament.—This ligament arises from the anterior edge of the smaller sigmoid cavity of the ulna, passes round the neck of the radius, and is inserted into the posterior edge of that cavity, thus completing the articulation of the radius with the ulna. It forms two thirds of a circle, and allows of the free motion of the radius in pronation and supination. Its surfaces are nearly covered by the external lateral ligament of the elbow-joint; its superior edge is connected with the anterior and posterior ligaments of that articulation;

but its inferior edge is free, and is in contact with the inferior portion of the synovial membrane.

The synovial membrane.—To obtain an accurate knowledge of this membrane, the tendinous expansion of the muscles, with the ligaments connecting the joint, and the subjacent fat, must be removed; we shall then find that it takes its origin from the anterior concave surface of the olecranon, passes down to line the whole of the great sigmoid cavity of the ulna, prolongs itself between the radius and ulna, covering the lesser sigmoid cavity, reaches as far as the neck of the radius, where it becomes reflected, forming a *cul de sac*, and here lines the inner surfaces of the coronary ligament; it then extends itself upon the posterior surface of the anterior ligament of the elbow-joint, passes over the two condyles of the os humeri, covers the anterior surface of the posterior ligament, and terminates at the point from which we began the description.

With respect to the dislocations of the elbow-joint, I am aware they are fully and accurately described by Sir Astley Cooper, in his work upon injuries to joints; but as these accidents are so frequent in their occurrence, and as a knowledge of their varieties is so essential, I shall not hesitate, although I may incur the imputation of plagiarism, to recapitulate the anatomical points to be observed, and the disposition of the

ligaments and muscles under each form of luxation to which this joint is liable. They are five in number.

First;—both bones may be dislocated backwards.

Secondly;—both may be dislocated laterally.

Thirdly; the ulna may be dislocated separately from the radius.

Fourthly;—the radius may be thrown forwards: and

Fifthly;—the radius may be dislocated backwards.

First, the dislocation of both bones backwards.—In this dislocation the radius and ulna are thrown upward behind the condyles of the humerus, and the coronoid process of the ulna occupies the fossa situated at the posterior part of the humerus, while the radius rests above the external condyle. The capsular ligament is torn through anteriorly. The internal lateral ligament is relaxed, and the external lateral is liable to have its anterior fibres lacerated. The coronary ligament suffers no change but in position, being drawn with the dislocated bones upwards and backwards. The biceps is considerably extended, but not to the same degree as the brachialis internus, in consequence of the more elevated situation of the coronoid process of the ulna, into which this muscle is inserted. The triceps muscle is relaxed from the approximation of its points of attachment; and the anconeus, although it must necessarily be relaxed, is in danger of having

some of its fibres lacerated by the forcible projection of the head of the radius above the external condyle, from which this muscle has origin. The muscles of the wrist, which arise from the condyles of the os humeri, are necessarily relaxed, excepting the supinator radii brevis, which has some of its fibres torn through.

Secondly, both bones laterally.—This dislocation can take place either to the inner or outer side; it is of rare occurrence, however, in comparison with the last mentioned accident. The state of the muscles and of the capsular ligament are under the same circumstances as in the dislocation backwards, with this unimportant difference, that the muscular fibres have an obliquity either outwards or inwards, depending on the direction of the dislocated bones.

Thirdly, the ulna backwards.—The only anatomical distinction between this accident and that of both bones being thrown backwards, is, that the ligaments peculiar to the radius and ulna, such as the *coronary* and *oblique*, are lacerated; while in the other accident, as the two bones are carried backwards together, the ligaments are not even put upon the stretch, nor do they undergo any other alteration than change of position.

Fourthly, the radius thrown forwards.—Here, as in the last mentioned dislocation, the ligaments injured are those

peculiar to the bones of the fore arm, and particularly the upper part of the interosseous ligament, the laceration of which allows the separation of the two bones.

Fifthly, the radius backwards.—The only important difference between this accident and the preceding is with respect to the biceps; in the former case this muscle is relaxed, while in the latter, the biceps is stretched by being drawn around the external condyle of the humerus.

The diagnostic marks of this dislocation, and the means to be employed for its reduction, are peculiar to the accident, and are so minutely described by Sir Astley Cooper, that I shall refer my readers to his work for information on that subject; merely reminding them, that in both the above accidents the extension should be made from the hand.

RADIO ULNAR ARTICULATION.

The radius and the ulna are connected along their whole course by ligaments; which, according to their relative situations, may be divided into those of the superior, middle and inferior articulations.

The superior articulation.—The upper extremity of the ulna is furnished with a small cavity (which is named the smaller sigmoid cavity), for the purpose of receiving the head of the radius, the surfaces of which are both covered with cartilage and synovial membrane, and these are continuous with those of the elbow-joint. This articulation forms a lateral hinge, admitting of the supination and pronation of the hand, but is not affected with the motion of flexion and extension of the fore arm. There is one ligament which connects this joint, viz.,

The coronary ligament.—It is composed of strong and

thick fasciculi, which arise from the posterior edge of the lesser sigmoid cavity of the ulna; it then passes around the neck of the radius, and is inserted into the anterior edge of the same cavity, thus forming three fourths of a circle, from which disposition it gains its name. This ligament passes in such close contact with the radius as to prevent any separation, but is not adherent to it, and therefore allows of the free rotatory motion of that bone; it is fibrous in its texture; the fibres pass in a circular direction, and are more obvious at its extremities than in its centre. The external surface of this ligament is covered by the muscles arising from the outer condyle of the humerus, and by the external lateral ligament; its internal surface is lined by the synovial membrane, which, as I have before said, is continued from the elbow-joint. Its superior circumference is connected with most of the ligaments of this articulation, while its inferior circumference is free.

MIDDLE RADIO ULNAR ARTICULATION.

There are two ligaments which serve to connect the radius and ulna nearly their whole length; they differ in their figure and in their use; the upper one is a mere chord which extends

transversely from one bone to the other, and assists in preventing their forcible separation; the other is a broad ligament, which fills up the space produced by the natural separation of the radius from the ulna, and not only connects these bones, but also gives origin to many muscles; and thus becomes included within the fourth class, as I have stated in speaking of ligaments in general.

First, the oblique ligament, is composed of thin fibrous fasciculi, which are rounded in their form, and originate on the outer side of the coronoid process of the ulna just below the insertion of the brachialis internus muscle; it then takes an oblique direction downwards and outwards, passes across from one bone to the other, and is inserted into the tubercle of the radius immediately below the insertion of the biceps; and as it crosses from its origin to its insertion, it forms an opening between it and the interosseous ligament, through which pass vessels and nerves. This ligament separates the superficial from the deep set of muscles of the fore arm, and is anterior to the interosseous ligament.

Secondly, the interosseous ligament, begins to arise immediately below the tubercle of the radius, and passes from the inner sharp edge of the radius to the outer edge of the ulna; it is not one uninterrupted extension of ligament, but consists of a great many flattened fasciculi, which are separated from

one another, leaving openings for the transmission of vessels and nerves; it extends as far inferiorly as to the connection of the radius with the ulna. Its two lateral edges are firmly connected with the periosteum of the two bones to which they are attached. Its anterior face above gives attachment to the deep flexor muscle of the fingers, and to the proper flexor of the thumb; its lower fourth is covered by the pronator quadratus muscle. On the posterior surface of this ligament may be seen some fibres which pass from the ulna to the radius, and which consequently cross the usual direction of the fibrous texture of the interosseous ligament, tending very much to strengthen it. This ligament is covered posteriorly by the supinator radii brevis, and extensor muscles of the fingers and wrist. There has been already mentioned one opening above, which is between the interosseous and the oblique ligaments, and which allows the passage of the interosseal vessels; but below there is another, of an oval form, just above the pronator quadratus muscle, extending through the ligament itself, and giving exit to the anterior interosseous vessels. The use of the interosseous ligament appears to be rather for the attachment of muscle than for the firm connection of the radius and ulna, which are so strongly bound together at each extremity as scarcely, in that respect, to need its support; it does,

however, assist in preventing the radius from being dislocated upwards without the ulna.

INFERIOR RADIO ULNAR ARTICULATION.

At the inferior extremity, the radius receives the ulna in a concave articular surface, which is covered with cartilage and synovial membrane, the two bones being retained in their situation by some anterior and posterior ligamentous fibres, which pass transversely from one bone to the other, and strengthen the synovial capsule. There is also an interarticular cartilage extending from the inner edge of the radius, and insinuates itself between the ulna and the bones of the carpus, which assist to complete this articulation. This cartilage I shall now proceed to describe.

Interarticular cartilage. — This cartilage, a production from the cartilaginous surface of the scaphoid cavity of the radius, proceeds from it obliquely inwards, and is placed transversely between the inferior extremity of the ulna and cuneiform bone, thus preventing the extremity of the ulna from coming in contact with the bones of the carpus, and

also, in consonance with all joints having interarticular cartilages, dividing the synovial membrane into two cavities.

Fig. 1.

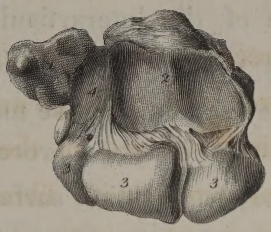
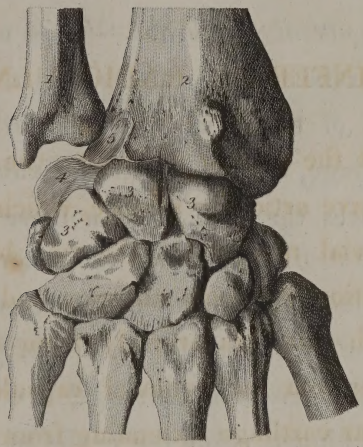


Fig. 2.



The external edge of this cartilage is connected with the lower and inner edge of the radius, while its internal edge is free, with relation to bone, being only attached to the styloid process of the ulna through the medium of the internal lateral ligament. Its superior surface is opposed to the inferior extremity of the ulna. Its inferior surface is in the same plane with the scaphoidal cavity of the radius, and opposed to the cuneiform bone of the first range of the carpus. During the

motions of pronation and supination of the hand, the interarticular cartilage is pressed against the styloid process of the ulna, and thus forms the fixed point for the motions of the radius.

Synovial membrane.—This membrane is situated between and reflected over the surfaces of the outer and lower extremity of the ulna, the superior surface of the interarticular cartilage, and the small articular cavity on the radius which receives the ulna. On a more accurate examination we may trace it, first covering the outer surface of the styloid process of the ulna, from thence it descends upon the superior surface of the interarticular cartilage, passes upon it outwards to the point where this cartilage is connected with the radius, then is continued upon the cavity of the radius which receives the ulna, passes over to that bone, forming a *cul de sac*, or sacciform ligament (as it is called), between the two, then descending along the articular surface of the ulna, and terminating at the place from whence I commenced the description; this synovial cavity being entirely separated from that between the radius and the bones of the carpus by the interarticular cartilage.

RADIO CARPAL ARTICULATION.

This joint is produced by the junction of the hand and the fore arm. The convex surfaces of the os scaphoides and the lunare are received into the cavity formed at the inferior extremity of the radius, while the cuneiform bone is opposed to the under surface of the interarticular cartilage; all of which are covered by a synovial membrane. This joint is further strengthened by the four following ligaments.

The anterior ligament.—This ligament is flat and delicate in its texture; it arises from the fore part of the inferior extremity of the radius, passes downwards and forwards to be inserted into the scaphoid, lunar, and cuneiform bones; it is covered by the tendons of the flexors of the fingers, and posteriorly it is lined by the synovial membrane.

The posterior ligament, arises from the lower and back part of the radius, and passes to be inserted into the lunar and cuneiform bones; this ligament is not so strong as the anterior; it is covered by the extensor tendons of the fingers, and is opposed to the synovial membrane.

The external lateral ligament, arises from the lower extremity or apex of the styloid process of the radius, descends to the bones of the carpus, is inserted into the outer side of the scaphoid bone, and from thence is continued to the trapezium; it is of a triangular form, the apex being attached to the radius, while the base is composed of diverging fibres, which pass before and behind, and are connected with the anterior and posterior ligaments which have been just described.

The internal lateral ligament, arises from the inner surface of the styloid process of the ulna, and passes downwards to be inserted into the cuneiform bone, from which it sends off a strip anteriorly to be connected with the os pisiforme. As this ligament passes from the ulna to the carpus it becomes attached to the interarticular cartilage, which divides the ligament into an upper and a lower half; the upper portion is covered by the synovial membrane of the ulna and interarticular cartilage, and the lower by the synovial membrane of the radial and carpal articulation. Both these last described ligaments are very strong, and prevent the displacement of the

bones, which might otherwise have been of frequent occurrence, from the extent of motion to which they are liable.

SYNOVIAL MEMBRANE OF THE RADIO CARPAL ARTICULATION.

This membrane covers the scaphoid cavity at the lower extremity of the radius, and the under surface of the interarticular cartilage; passes anteriorly from these points of attachment to the inner surface of the anterior ligament of the wrist-joint, and to the lower half of the internal lateral ligament; then passes upon the superior surfaces of the scaphoid, lunar and cuneiform bones, dipping in between each to line their connecting faces, and forming a synovial cavity between them; ascends upon the posterior ligament, passes sufficiently far outwards to give a lining to the external lateral ligament, and terminates at the point from whence this description began.

From these particulars it is clear that there are two joints at the wrist; the one is named the inferior radio ulnar articulation, which does not form a joint with the bones of the carpus, but allows the radius to roll upon the ulna, and

perform the motions of pronation and supination of the hand, while the radio carpal articulation admits of the motions of flexion and extension, and forms a joint with the three outer bones of the first carpal row;—not that the cuneiform bone is in contact with the radius, but that it is still connected with it by the same synovial membrane which is common to the other two bones of the carpus.

Before I begin the description of the ligaments proper to the bones of the carpus, I shall first give an account of such as tie down the tendons of those muscles which serve for the motions of the hand and fingers, and are found on the dorsal and palmar regions of the wrist.

First;—on the palmar region.

The ligamentum carpi annulare.—This ligament which is extremely strong, passes anteriorly to the concave arch of the carpus for the purpose of tying down the tendons of the flexor muscles of the fingers, and also assists in preventing displacement of the carpal bones under any violent application of force. It arises from the pisiform bone and from the hook-like process of the unciform, passes transversely across the carpus, and is attached to the scaphoid and trapezium. Its posterior surface is in contact with the flexor tendons of the fingers, and the anterior is covered by the aponeurotic expansion of the palmaris longus, and by the muscular fibres of the

palmaris brevis; by the ulna artery, and by the superficial volar branch from the radial. The ulna artery, however, as it runs over the ligament, is protected by a process of it which passes from the pisiforme bone, or rather from the insertion of the flexor carpi ulnaris, outwards to the middle of the superior edge of the annular ligament, and thus forms a groove for its safe transmission.

Ligamentum carpi annulare dorsale.—This ligament is situated on the posterior part of the wrist; performing the same office, in tying down the extensor tendons of the hand and fingers, which the preceding ligament performs for the flexors. It arises from the styloid process of the radius, passes in an oblique direction from without to within, to be attached to the styloid process of the ulna, and in its passage along the posterior surface of these bones, it is connected with the edges of the grooves which allow the passage of the extensor tendons, and thus forms sheaths for their protection and transmission. Its posterior surface is only covered by skin and cellular membrane, while anteriorly it is in contact with the tendons and a membrane which secretes a fluid to lubricate them, and, consequently, prevents friction on their various motions. Its inferior edge sends off an aponeurotic expansion, which passes over the back of the hand, and assists in maintaining the extensor tendons in their passage to the fingers.

LIGAMENTS PROPER TO THE CARPUS.

I HAVE already mentioned, that the first, or cubital row of the carpus receives its synovial membrane, for its junction with the radius, from a prolongation of the membrane of the radio carpal articulation; but this joint is further strengthened by other ligaments, which connect the bones of this row firmly together, and are situated between these bones on their anterior and on their posterior surfaces.

Interosseal ligaments.—These ligaments connect the scaphoid, the lunar, and the cuneiform bones, being composed of dense strong fibres, which are laterally united firmly to them, while their superior face is covered with the synovial membrane, to which they are firmly attached.

Anterior, or palmar ligament.—It is found situated immediately under the anterior ligament of the wrist-joint, takes an

oblique direction from without to within, being connected to the scaphoid, lunar and cuneiform bones; and as it passes from one of these bones to the other, connects itself with the interosseal ligaments.

Posterior, or dorsal ligament.—This ligament has attachment to the same bones as the palmar ligament; its posterior surface is in contact with the posterior ligament of the wrist-joint, and its anterior with the interosseous ligament; it also tends to strengthen this row of the carpus.

ARTICULATION OF THE PISIFORM BONE.

This bone being situated anteriorly to the other bones of the carpus, has a peculiar articulation with the cuneiform, which is composed of a synovial membrane lining the articulatory surface of each bone; it has also an inferior ligament, which connects it with the hamillary process of the unciform bone, and is further strengthened and maintained in its situation by the insertion of the flexor carpi ulnaris.

Second or digital row.—This row is connected by interosseal, palmar and dorsal ligaments, precisely similar to the cubital row; it passes from without to within, in a transverse

direction, from the trapezium to the unciforme, and is attached to the intermediate bones.

ARTICULATION OF THE TWO ROWS OF THE CARPUS WITH EACH OTHER.

This articulation consists of three distinct joints, viz., the trapezium and trapezoides with the scaphoid; the unciform with the cuneiform; and the os magnum with the lunar and scaphoid bones: the two first forming the hinge-joint, while the latter is composed of a ball and socket. These joints are connected by external and internal lateral, anterior and posterior ligaments, and by synovial membrane.

The lateral ligaments, appear to be nothing more than a continuation of the external and internal lateral ligaments of the radio carpal articulation; being fixed, as they descend on the outer side, to the scaphoid and the trapezium, on the inner side, to the cuneiform and unciforme bones.

The anterior and posterior ligaments, are formed of fibrous fasciculi, which pass in various directions from the cubital to the digital row.

The synovial membrane, not only covers the articulatory

surfaces by which the bones of the carpus are connected, but also insinuates itself between them so as to form one synovial cavity.

ARTICULATION OF THE CARPUS WITH THE METACARPUS.

First, the metacarpal bone of the thumb with the trapezium.—This is a hinge-joint, and is connected by a strong *capsular ligament*, which passes from the neck of the metacarpal bone of the thumb to the edge of the articulatory surface on the trapezium. It is loose, having its internal surface lined by synovial membrane, while its external surface is strengthened by the muscles of the thumb.

The four other bones of the metacarpus are connected with the carpal bones by *synovial membrane*, which seems to be a continuation of that of the carpus, and by *dorsal* and *palmar ligaments*, proceeding from the inferior extremity of the digital row, to be attached to the necks of the metacarpus.

ARTICULATION OF THE BONES OF THE METACARPUS WITH ONE ANOTHER.

The inferior extremities of these bones are connected by *transverse ligaments*, which are divided into two sets of fibres, one superficial, and the other deep; the latter are the shorter, and exclusively deserve the name of intertransverse, passing from one bone to the other, having their anterior faces crossed with four depressions, which answer to the passage of the tendons of the flexor muscles of the fingers, and to the lumbricales. Its posterior surface is connected with the tendons of the interosseous muscles, and with the ligaments connecting the phalanges with the metacarpus; while the superficial fibres pass across all the metacarpal bones, excepting that of the thumb, and may be divided into *dorsal and palmar transverse ligaments*.

ARTICULATION OF THE METACARPUS WITH THE PHALANGES.

The round inferior extremity of the metacarpus is admitted into the cavity of the superior extremity of the first phalanx

of the five fingers, and their joints are connected by anterior and lateral, which form capsular ligaments, and by a lining of synovial membrane.

The anterior ligament, is a half annular ligament, attached to the fore parts and sides of each metacarpal bone, immediately below their intertransverse ligaments, from whence it passes to be inserted into the superior extremity of each phalanx. It is in the thick part of this ligament that the sesamoid bones of the thumb are placed, between which its proper flexor muscle passes.

The lateral ligaments, proceed from the sides of the inferior extremity of the metacarpal bones, as far as to the sides of the superior part of the phalanges. These ligaments are connected with the sheaths which protect the tendons of the flexor muscles, and their edges are in contact with the vessels and nerves of the fingers.

The synovial membrane, covers the cartilaginous surface of the bones of the metacarpus, passes behind the anterior ligament and within the lateral, and surrounds the articular surface of the phalanx; it then forms a loose capsule under the tendon of the extensor muscle.

ARTICULATION OF THE PHALANGES.

The articulation of these bones with one another form a perfect hinge-joint; they have each a capsular, an anterior, and two lateral ligaments, which, in situation and attachment, resemble so much those of the articulation of the phalanges with the metacarpus, as to render further description unnecessary.

DISLOCATIONS TO WHICH THE WRIST-JOINT IS LIABLE.

It sometimes happens, that the convex surfaces of the three first bones of the carpus are separated from the concave surfaces of the radius and interarticular cartilage; and it is possible for the carpus to be thrown either backwards, forwards, externally, or internally; but from the formation of the wrist-joint, the dislocation backwards is the most frequent; the convex articular surfaces of the three first bones of the carpus sloping in that direction. This accident usually occurs from a fall upon the back of the hand while the hand is flexed; the force being then applied to the anterior extremities of the metacarpal bones, the carpus is tilted over the posterior surface of the radius, and the deformity immediately produced; which with the consequent shortening, and permanent flexion of the

hand, render the nature of the accident at once sufficiently apparent. The posterior ligament of the wrist is necessarily torn through, and the lateral ligaments may have some of their anterior fibres ruptured.

DISLOCATION FORWARDS.

This accident, which but rarely occurs, is usually produced by a fall on the palm of the hand during extension, and the carpus is driven before the radius; the hand is painfully extended and shortened, and the deformity considerable, but not so obvious as in the last described accident, particularly as the dislocation is scarcely ever complete, and the cavity of the hand renders its detection more difficult. In this dislocation the anterior ligament is torn through, and the lateral ligament is placed under the same circumstances as in the last described accident.

In the *lateral dislocations*, the displacement can never be complete; but a projection of the carpus on the inner or outer side is a sufficient diagnostic mark of the nature of the injury. The degree of laceration of the anterior, posterior and lateral ligaments, is in proportion to the extent of displacement. In

any of the dislocations of the wrist-joint, if the case be recent, reduction is easily accomplished by slight extension of the hand; and, therefore, no time should be lost in reducing the bones to their natural situation, not allowing time for a fixed contraction of the muscles.

DISLOCATIONS OF THE CARPUS.

The displacement of these bones from one another without fracture, may be considered as almost impossible; but it has, in some cases, happened, that the os magnum has been thrown from the cavity formed for it by the lunar and scaphoid bones, on the back of the hand, there forming a considerable tumour. The means to be employed for its reduction are sufficiently obvious; force should be applied upon the dorsal surface of the dislocated bone, while the hand is kept in an extended position.

DISLOCATIONS OF THE METACARPUS.

The luxation of these bones from the carpus is but of rare occurrence, even with respect to the metacarpal bone of the thumb and the os trapezium, notwithstanding the extent and variety of motions of which the thumb is capable; but displacement does, however, sometimes take place in the metacarpal bone of the thumb, which is thrown backwards upon the trapezium, under its extensors. In this case the capsular ligament is torn through. The means to be employed for its reduction are merely forcible extension.

DISLOCATIONS OF THE PHALANGES.

The first phalanges present a concave surface to receive the convex extremities of the metacarpal bones; and, in consequence of the rounded surfaces of these bones extending much further forwards than backwards, the first phalanx can scarcely be thrown into the palm of the hand, but is forced backwards on the metacarpal bones. This accident most frequently occurs to the thumb, and may be readily known

by the deformity on the metacarpus, and by the extension of the first, while the second phalanx is bent. The dislocation is very difficult to reduce, and particularly if any length of time has elapsed between the accident and the attempt at reduction. The other phalanges are also liable to similar dislocations.

LIGAMENTS OF THE PELVIS.

These ligaments may be divided into two sets; those which attach the pelvis to the vertebræ, and those which connect the different bones of the pelvis with each other. There are but two of the first order which differ, in any respect, from the ligaments common to the vertebræ; for the superior surface of the sacrum is found connected with the last lumbar vertebræ by an intervertebral substance; a continuation of the common anterior and posterior ligaments of the vertebræ also strengthens this connection; capsular ligaments are found attaching the articular processes of the sacrum to the last lumbar vertebra; and, lastly, similar interspinous ligaments, and a continuation of the ligamentum subflavum, serve to connect them. To these, however, two others must be superadded, viz.:—

First, the sacro lumbar, which arises from the inferior and

anterior part of the transverse process of the last lumbar vertebra, and passes downwards and outwards to be inserted into the superior part of the sacrum. This ligament is of a triangular form, its apex being above, where it is connected with the ilio lumbar, and its base being below; its fibres are intermixed with those of the ilio sacral. Its anterior surface is covered by the psoas magnus muscle, while posteriorly it covers the posterior fibres of the ilio lumbar ligaments.

Secondly, the ilio lumbar ligament, arises from the transverse process of the last lumbar vertebra, and passes outwards to be attached to the posterior and superior spinous process of the ilium, extending as far downwards, anteriorly, as to be mixed with the fibres of the sacro iliac ligaments; in this situation the ligament is divided into two sets of fibres, which gain the distinction of superior and inferior transverse ligaments of the pelvis. Above, this ligament is covered by the quadratus lumborum muscle; anteriorly, by the psoas magnus; and, posteriorly, it partially gives origin to the lumbar mass of muscle.

JUNCTION OF THE BONES OF THE PELVIS WITH ONE ANOTHER.

Articulation of the sacrum and the os coccygis.—This union is completed in the same manner with that which is common to the vertebræ; for, the apex of the sacrum, and the base of the os coccygis, have corresponding oval surfaces, connected by a fibrous cartilaginous substance, similar to the intervertebral substance, but not so thick; a continuation of the common anterior and posterior ligaments of the vertebræ, serve to strengthen this articulation, so that a further description of these ligaments is unnecessary.

Sacro iliac articulation.—This union, termed the sacro iliac symphisis, is formed by the junction of the sacrum and ilium through the medium of an intervening cartilage. There are four ligaments which serve to render this articulation firm.

The posterior sacro sciatic ligament, arises from the posterior and inferior spinous process of the ilium, from the sides of the sacrum, and from the first bone of the os coccygis; it then passes outwards and downwards to be inserted into the tuberosity of the ischium, being there connected with the tendinous origin of the flexors of the leg. Upon the inner side of this

portion of bone it extends itself into a ligamentous expansion, from the shape of which it has gained the name of the *falciform ligament*, which runs up on the ascending ramus of the ischium, and forms a canal for the pudic artery to pass, and also gives origin to the obturator internus muscle. From the posterior surface of this ligament arises the gluteus maximus muscle; its anterior face is connected with the anterior sacro sciatic ligament, leaving a triangular space between them, which gives passage to the obturator internus muscle, and to the pudic vessels and nerves.

The anterior sacro sciatic ligament.—This is the smaller ligament of the two, but of the same form as the last described, before which it is situated. It arises, in common with the posterior ligament, from the ilium, sacrum, and os coccygis, being composed of the most anterior fibres; it passes forwards and inwards to be inserted into the spinous process of the ischium; its posterior surface is covered by the posterior sacro sciatic ligament; its anterior gives origin to the coccygeus muscle. These two ligaments divide the great sciatic notch into two openings; through the upper, which is the larger, passes the pyriformis muscle, the gluteal, and sciatic vessels and nerves; and through the inferior, the obturator internus muscles, with the pudic vessels and nerves. These ligaments exist not only for the purpose of connecting the

bones of the pelvis, but also of sustaining its viscera, and diminishing the size of its openings.

The sacro iliac ligaments, connect the sacrum and ilium both before and behind, passing from the two upper bones of the former to the sides of the ilium, and thus enveloping the intervening cartilage; the anterior sacro iliac ligament is covered by the psoas magnus, and the posterior by the gluteus maximus. There are, however, several other irregular ligamentous fibres concurring to connect the ossa innominata with the sacrum; but their course is so indistinct and uncertain, as to render it unavailing and useless to attempt its description.

LIGAMENTS OF THE PUBES.

The pubes are connected by the junction of their two symphyses with an intervening fibro cartilaginous substance, which is more thick anteriorly than posteriorly; and their union is rendered firmer by anterior and posterior ligaments, which pass transversely from the one bone to the other.

The anterior ligament, is composed of transverse ligamentous fibres, which pass from one side to the other, anteriorly to the intervening cartilage; it is connected with the periosteum of the pubes, and the aponeurotic expansion from the abdominal muscles.

The posterior ligament.—This is stronger than the preceding; it is triangular, and is attached to the superior part of the arch of the pubes, passing some way down on the sides of the descending rami of this bone, and forming a slight

curve, the concavity of which faces downwards. It forms the triangular ligament of the pubes; and, from its inferior edge, a strong fascia is given off, which separates the perinæum from the contents of the pelvis; admitting, however, the urethra to pass through it.

The obturator ligament.—This ligament come particularly under consideration as one of the fourth class, being destined entirely for the purpose of presenting an extension of surface for the origin of muscle, and not for the usual office of binding bones together. It arises from the whole circumference of the obturator foramen, closing it every where excepting at its upper part, where it leaves a small opening for the passage of the obturator vessels and nerves; its fibres take an irregular course, frequently intersecting one another. Its anterior surface gives attachment to the obturator externus; and its posterior to the obturator internus, and part of the levator ani muscles.

MOTIONS OF THE PELVIS.

The motions of the pelvis may be considered as twofold. First, as a whole, upon the vertebral column, and on the ossa

femoris; and, secondly, with regard to the motions between the separate bones entering into its composition: but it is only to the latter that I shall call the attention of my readers at present. The degree of motion between any two of the bones entering into the formation of the pelvis is but very slight in the natural state; unless, indeed, we except the articulation between the sacrum and the os coccygis, which does allow of motion backwards and forwards. But this articulation still comes under the fair denomination of an immoveable joint, in contradistinction to those, which, being under the influence of the will, are moved, consequently, by the action of voluntary muscles, while this joint cannot be acted upon except by some compression, such as the expulsion of the fœtus, which pushes this bone backwards, or pressure from without, which gives it the contrary direction. The sacro iliac symphysis, and the junction of the pubes, will also sometimes admit of a slight degree of motion between them, from the continued pressure during protracted parturition. Under any circumstance, however, they are so firmly connected as to preclude the possibility of dislocation, unless, indeed, such be the result of disease and subsequent ulceration. When these bones are exposed to the greatest external violence, we find them rather fractured than separated from each other at their articulatory surfaces. Should such an accident, however, by any possible degree of

violence occur, the same means would be employed as in fracture of these bones,—the application of a broad bandage, so as to keep the parts in their relative position; and at the same time pass a catheter into the bladder, to ascertain whether or not injury be done to the urethra.

ARTICULATION OF THE LOWER EXTREMITIES.

Ilio femoral articulation.—This joint is produced by the union of the head of the femur with the cotyloid cavity of the os innominatum; but this cavity is not, with respect to the bone only, of sufficient depth to receive the whole of the head of the femur; for, in a recent state, we find it much more capacious than in a dried bone, from the addition of a fibro ligamentous substance investing its circumference; by the assistance of which it so completely surrounds the head of the femur, as to allow of the motions of the hip joint without permitting the separation of one bone from the other, an effect which takes place in the various motions of the shoulder. The surfaces of both the ball and socket of this joint are every where covered with cartilage, excepting the points of attachment of the ligamentum teres. The following ligaments serve

to strengthen this articulation, viz. :—The capsular, the inter-articular (or ligamentum teres) and the cotyloid ligament, all of them lined by the synovial membrane.

Capsular ligament.—This ligament, which is the strongest and thickest in the body, surrounds the whole of the joint. It begins to arise from the circumference of the acetabulum, and proceeds in a direction outwards and backwards, to be attached to the base of the neck of the femur, extending outwards to the pit of the trochanter major, and downwards to the trochanter minor ; in the intermediate space it is connected with the linea quadrata. It is much less loose than the capsular ligament of the shoulder joint, being formed more for strength than for extent of motion, but in other respects it is analogous. Its thickness is very considerable, particularly before and above, where it is strengthened by an accessory ligament, which passes from the anterior and inferior spine of the ilium to the fore part of the capsular ligament, to which it is firmly united. On the inner side, the fibres of this ligament are often so much separated as to leave a space between them, exposing the synovial membrane ; and then it is again strengthened by fibres, which pass downwards from the obturator foramen. The whole external face of the capsular ligament of this joint is covered by the insertion of muscles destined for the motion of the thigh-bone : its internal surface is lined by synovial membrane.

The interarticular ligament, or ligamentum teres.—This is composed of ligamentous fibres, which pass from the inner and fore part of the cotyloid cavity to a rough fossa on the head of the femur. Its form is that of a triangle, the apex of which is attached to the thigh-bone, and its base, which is bifurcated, forms two flattened bands, which pass around the circumference of the foramen produced by the cotyloid ligament passing over the notch of the acetabulum. The superior band is of less extent than the inferior, but both are attached to the cotyloid ligament.

The cotyloid ligament.—The circumference of the cotyloid cavity is surrounded by this fibro ligamentous substance, which renders it perfectly regular, and forms into a foramen the notch which is situated in the under and fore part of that cavity, leaving a space for the passage of blood-vessels to the ligamentum teres. It is connected with the bony edge of the acetabulum by a comparatively broad base, while its apex is a free border a little inclined inwards. Its internal surface is covered by the synovial membrane; its external is in contact with the capsular ligament.

Synovial membrane.—This membrane arises from the cartilage of the head of the femur; it is then continued along its neck as far as its base, from whence it becomes reflected on the capsular ligament, covering it throughout its whole extent;

it then passes on the inner surface of the cotyloid ligament into the cavity of the acetabulum, at the bottom of which it forms folds or fimbriæ, for the purpose of enlarging the surface for the secretion of its fluid, but, from its appearance, it has gained the name of a synovial gland; from thence it passes along the ligamentum teres to the head of the femur, the point at which we began our description. As this membrane passes along the ligamentum teres, it secludes it from its secreting cavity, precisely in the same manner as the abdominal viscera are secluded from the cavity of the peritoneum. The whole circumference of the head of the thigh-bone has many little granular substances on it, which appear to be folds of the synovial membrane; there is one, in particular, to be found immediately below the insertion of the interarticular ligament. This articulation is provided with blood-vessels and nerves from the obturator artery and nerve, just at their passage through the obturator foramen, and also from the anterior circumflex artery.

MOTIONS OF THE HIP-JOINT.

The motions of the hip-joint are much the same with those of the shoulder, excepting that the rotatory motions are to a much less extent, in consequence of the greater depth of the acetabulum, in relation to that of the glenoid cavity of the scapula, and of the comparatively stronger and shorter capsular ligament; but the joint is capable of flexion, extension, abduction, adduction, rotation outwards, rotation inwards, and circumduction.

First, flexion.—When the femur is flexed the thigh is bent upon the pelvis, and its inferior extremity is carried forwards; the great trochanter is thrust backward towards the sciatic notch; the head rolls in the acetabulum on its own axis. The capsular ligament is slightly stretched posteriorly; but, if flexion be carried to its greatest degree, the distension of the

ligament becomes considerable, in proportion to the extent of action.

Secondly, extension.—This motion is produced by the inferior extremity of the thigh-bone being carried backwards; the trochanter major is brought forwards, and is situated immediately under the anterior and superior spinous process of the ilium. The capsular and interarticular ligaments are put upon the stretch, in consequence of the disposition of the head of the thigh-bone to leave the cotyloid cavity; it is forcibly pressed on the anterior part of its capsule, which is, in this situation, rendered stronger by the accessary ligament, as before described.

Thirdly, abduction.—In this action the thigh is separated from the other laterally; the great trochanter is, when abduction is carried to its fullest extent, brought into contact with the dorsum of the ilium; the internal part of the capsular ligament and ligamentum teres are stretched.

Fourthly, adduction.—This motion consists of little more than the return of the limb to its natural position after abduction has been performed; but it can be carried to a greater degree, so as to make the superior extremity of one thigh-bone cross the other; in which case the trochanter major is carried a little below, and anterior to, its natural situation. The capsular and interarticular ligaments are somewhat stretched.

Fifthly, rotation.—This may be either *outwards* or *inwards;* the former action seems to be most consistent with the position of the limb ; and we find, therefore, an infinitely greater muscular apparatus to produce it, than to roll the thigh inwards. When this motion is carried to its greatest extent, the great trochanter is thrown behind the acetabulum, and the head of the bone is thrown forward, pressing against the capsular ligament.

Rotation inwards.—In this case the inferior extremity of the femur is turned inwards, and the trochanter so brought forward towards the spine of the ilium, as to make a perceptible projection under the skin ; and the head of the bone turns upon its own axis, towards the back part of the acetabulum. In these rotatory motions the foot should not be made the guide by which we can judge of their extent, as that is influenced by the motions of all the joints of the inferior extremity.

Sixthly, circumduction.—This is produced by the quick succession of all the motions of which the hip-joint is capable ; and, as might be supposed from the structure of the joint, is limited to a considerably less extent than that in the shoulder. The ligaments and muscles adapt themselves to each motion as rapidly as they occur.

DISLOCATIONS OF THE HIP-JOINT.

HAVING ascertained the motions of which this joint is capable, we may easily understand the different directions in which the head of the thigh-bone may be thrown from the acetabulum, viz :—

First, upwards and backwards upon the dorsum ilii.

Secondly, downwards and forwards into the foramen ovale.

Thirdly, backwards into the ischiatic notch.

Fourthly, forwards upon the pubes.

DISLOCATION UPWARDS AND BACKWARDS ON THE DORSUM ILII.

This is the most frequent luxation of the thigh-bone ; and,

although in many respects it offers the same diagnostic marks as the other dislocations, yet there are some peculiar circumstances which render the nature of the accident at once obvious; and its most prominent characteristic is, the great degree of shortening of the limb, its rotation inwards, so as to bring the trochanter major much nearer to the anterior superior spinous process of the ilium; the foot, on the injured side, rests upon the tarsus of the opposite one, and the knee is partly flexed, and in advance of the other. The roundness of the hip is lost in consequence of the ascent of the head of the thigh-bone upon the dorsum of the ilium, and the consequent relaxation of the glutei muscles; the pyriformis is somewhat relaxed, but the obturatores gemini and quadratus muscles are stretched. The psoas and iliacus are relaxed, as must be all those muscles arising from the pelvis, and inserted into the bones of the lower extremity, below the trochanter major, in consequence of the approximation of their points of attachment. The capsular ligament is torn through, so as to admit of the escape of the head of the bone, and the ligamentum teres is also lacerated.

The accidents with which this dislocation may be confounded are, the luxation of the head of the thigh-bone into the ischiatic notch, and the fracture of its neck; from the first it may be distinguished at once by the greater degree of

shortening, which is such as to cause the toe of the injured side to cross the tarsus of the opposite foot; while in dislocation into the ischiatic notch, the toe, on the dislocated side, is only directed to the ball of the great toe on the other. From fracture of the cervix femoris it is easily distinguishable, if but common attention be paid, for there is nothing similar in the two accidents excepting the shortening of the limb; and the fixed position of the joint in dislocation, and its moveable state in fracture, will at once preclude the possibility of mistaking one injury for the other.

DISLOCATION OF THE THIGH-BONE DOWNWARDS AND FORWARDS INTO THE FORAMEN OVALE.

The diagnostic marks of this injury are so completely characteristic, as to render its nature at once obvious. The limb is lengthened to a considerable degree, the thighs are widely separated from one another, and the knee of the injured limb is advanced; the foot is somewhat everted, and the toes only rest upon the ground; the pelvis is bent upon the thighs, in consequence of the state of tension incident to the psoas and iliacus muscles, and the roundness of the thigh is lost by the

stretched state of the muscles situated upon it. The head of the bone can be felt deeply seated on the inner and superior part of the thigh; the trochanter major is considerably removed from the anterior superior spinous process of the ilium; and the voluntary motion of the extremity is totally lost. The capsular ligament is lacerated, as well as the ligamentum teres, although some have said that the latter is not necessarily torn through; but the head of the bone cannot be thrown completely out of the acetabulum, in any direction, without producing such a consequence. The increased length of the limb, the separation of the thighs, and the bending of the body, are, therefore, the diagnostic symptoms.

DISLOCATION FORWARDS ON THE PUBES.

This is an accident of rare occurrence, compared with the two preceding, but it does occasionally take place, and may be at once known from any of the other luxations to which the thigh-bone is liable, by the rotation outwards of the whole limb, the head of the bone being felt just above Poupart's ligament in the situation of the anterior crural nerve, upon which it sometimes presses so as to produce numbness and

pain. The trochanter major is nearer to the anterior superior spinous process of the ilium; and the impossibility of producing rotation inwards of the injured limb, sufficiently marks the nature of the accident.

This dislocation is the accident of all others most liable to be confounded with fracture of the neck of the thigh-bone; being alike characterized by shortening of the limb, and eversion of the foot; but the fixed state of the limb in dislocation, and the comparative facility with which it may be moved in fracture of the neck, form an unequivocal distinction.

DISLOCATION BACKWARDS INTO THE ISCHIATIC NOTCH.

In this case the head of the bone is thrown behind the acetabulum, and a little above the centre of that cavity; so that the limb is somewhat shortened, and the foot inverted, with the great toe on the injured side resting on the ball of the opposite one. From the depth at which the head of the bone is placed, it is with difficulty felt; but it is found resting on the pyriformis muscle. This dislocation is, in every respect, the most difficult to discover; but the points to be observed

are, the loss of motion of the joint, accompanied by but slight shortening of the limb, not more than to half an inch, and by inversion of the foot. With respect to the modes of reduction of the dislocations of the hip-joint, I beg leave again to refer to Sir Astley Cooper's book on this subject: and shall myself only remark, that the surgeon should remember, that his sole opposing force is muscle; and, therefore, that it is quite essential for him to understand the position of these organs under the different luxations of this joint, that his judgment may decide on the best means of placing them under those circumstances, in which they can offer the least opposition to his efforts in reduction. He will have no difficulty in making this decision who remembers that dislocation can only occur in the direction of the natural motions of a joint; from whence the inference is clear, that the same muscles which govern those motions are now morbidly affected by the displacement of the bone.

LIGAMENTS OF THE KNEE;

OR,

FEMORO TIBIAL ARTICULATION.

This is one of the most complicated joints in the body, and is produced by the union of the following bones:—The condyles of the femur, the superior extremity of the tibia, and the posterior surface of the patella. Cartilage covers all these surfaces, which are connected by synovial membrane; and the following ligaments serve to strengthen the articulation:—First, those of the patella; and, secondly, those common to the femur and tibia.

The ligament of the patella, is in fact, nothing more than a continuation of the tendons of the extensor muscles of the leg, which completely envelop the patella, becoming attached to its inferior edge or apex, and passing from it to the tubercle of the tibia; anteriorly it is covered only by skin, and by a

prolongation of the fascia lata; its posterior surface is in contact with fat and the synovial membrane of the joint, and below a bursa is formed between it and the tibia; its edges are in contact with the tendinous insertion of the vasti, and with that portion of the synovial membrane which gains the name of the alæ ligaments. The fibres of this ligament pass from above to below in parallel lines, which are strengthened by cross bands.

The long external lateral ligament.—This ligament is posterior to the centre of motion, so as not to be put upon the stretch under the various actions of the joint. It is composed of vertical fibres, which descend from the external condyle of the femur to be attached to the head of the fibula; it is covered in a great part of its extent by the tendon of the biceps muscle, and its inner surface is applied to the external semilunar cartilage, and to the synovial membrane. The inferior articular vessels pass on the inner side of it.

The short external lateral ligament, which appears to be an accessory to the other, is placed posteriorly to it, and running in a parallel line, passes from the outer side and posterior part of the external condyle, downwards, to the head of the fibula to which it is attached.

The internal lateral ligament.—This is also posterior to the centre of the joint. It is of a triangular form, its apex arising

from the posterior part of the internal condyle of the femur, and its base being attached to the internal edge of the head of the tibia; its fibres are more flattened than the external ligaments of the knee-joint; it is rather thicker before than behind, where it is connected with the posterior ligaments of Winslow by a strong aponeurosis. This ligament is covered above by the insertion of the vastus internus, and below by the sartorius, gracilis, and semitendinosus muscles; the ligament itself covers the synovial membrane.

The posterior ligament.—This ligament forms a great protection to the back part of the joint. It passes transversely from without to within, arising from the external condyle of the femur, and being inserted into the back part of the tibia, where it is intimately connected with an aponeurotic expansion from the tendinous insertion of the semimembranosus muscle; which muscle, in flexion of the knee, prevents this ligament from being pressed between the bones. This, at least, is the function usually ascribed to the attachment of that muscle to the posterior ligament; but I believe a much more important purpose may be assigned to it,—that of keeping the external semilunar cartilage in its natural position under all the various motions of the joint. Its fibres take an irregular course, leaving several apertures for the transmission of blood-vessels; its posterior surface is covered by the popliteus muscle, its

anterior is in contact with some fat which is interposed between it and the posterior crucial ligament, leaving a space for the middle articular vessels.

The anterior crucial ligament, arises from the inner and back part of the external condyle, and is directed obliquely downwards and forwards to a depression in the front part of the spine of the tibia; it is covered before by the synovial membrane, and is in contact behind with the posterior crucial ligament: this is the ligament, which, in the semiflexed position of the knee-joint, prevents the rotation of the tibia inwards, except to a very slight extent.

The posterior crucial ligament, crosses the direction of the preceding, arising from the internal condyle, and passing outwards, although not with the same degree of obliquity as the anterior, to be attached to the posterior part of the spine of the tibia; its course is but little out of the vertical line; its base, which is connected with the tibia, is continued to be attached to the external semilunar cartilage; behind, it is covered by the posterior ligament of the joint, and by the middle articular arteries; before, it is applied to the anterior crucial ligament. The crucial ligaments cannot be said to be within the knee-joint, although they are sometimes designated as the internal ligaments, being really external to the synovial membrane.

Semilunar cartilages, are situated between the condyles of the femur and the upper face of the tibia, which they render more concave: they are, as their name implies, of a semilunar form, and much thicker at their greater than at their smaller circumference; they are less in extent of surface than the upper part of the tibia, not occupying more than its two external thirds, and are distinguished according to their relative situation, into internal and external.

The *internal* is nearly semicircular, rather longer and larger behind than before; its convex edge is turned inwards, and is connected with the internal lateral ligament; its anterior extremity is attached to the spine of the tibia, and to the anterior crucial ligament; its posterior extremity is fixed to the tibia only.

The *external* forms a greater share of the segment of a circle than the preceding; is larger before than behind; its convex edge is turned outwards, and is in contact behind with the popliteus muscle, in the middle part with the external lateral ligament, and in the fore part with the tibia, being placed behind the anterior extremity of the internal cartilage; while behind it is anterior to the corresponding extremity of its fellow. These cartilages are composed of fibres, which are more perceptible in their convex than concave edges; they are anteriorly connected to one another by a short *transverse*

ligament; their superior surfaces are concave, their inferior flattened, and both are covered by synovial membrane, which is reflected under their free concave edges.

The synovial membrane, takes a course rather difficult to trace, as it lines the inner surfaces of all the ligaments, as well as the cartilaginous surfaces of the bones entering into the composition of the knee-joint. We will first trace it from the inner surface of the extensor tendons of the leg, just as they are inserted into the patella. From this point it proceeds upwards, lining the under surface of this tendon as high as the condyles of the femur, upon which it then becomes reflected, forming a *cul de sac* between the two; it passes round the extremity of the femur as far backwards as the posterior ligament; at the same time surrounding the crucial ligaments, so as to leave them posterior to its cavity. From thence it is continued on the superior surface of the semilunar cartilages, lining also the external and internal lateral ligaments; it then dips under the concave free edges of the semilunar cartilages, covers the whole superior articular surface of the tibia, and proceeds from the anterior point of this bone to the inner surface of the ligament of the patella, extending laterally to the anterior edges of the two lateral ligaments. These at the points where they are attached to the edges of the ligamentum patellæ, are called the *alæ liga-*

ments. It then rises upon the inner surface of the patella, and passes from its base upon the tendon of the extensor muscles, from whence we began the description. There is also a portion of the synovial membrane which passes from the tibia, like a chord, to the femur, between its condyles, and which is called the *mucous ligament;* it is composed of a number of little fimbriated processes, which receive the ramifications of the articular arteries.

MOTIONS OF THE KNEE-JOINT.

The articulation of the femur with the tibia forms a complete hinge-joint, which is anteriorly protected by the patella; and, with respect to its motions, is capable of flexion, extension, and some slight degree of lateral motion, during the flexed position of the leg. When the limb is flexed the leg is capable of being carried very far back, so as to form an acute angle with the thigh; and this extensive motion is allowed in consequence of the larger articular surfaces of the condyles being placed posteriorly; while, in extension, the leg cannot be carried further forwards than to the straight line, during which action no lateral motion can take place in the knee-joint, and thus more stability is given to the limb. But during slight flexion, such as takes place in progression, we are capable, from the degree of lateral motion, which, under

these circumstances, the joint enjoys, to direct our steps in a lateral direction; but this can take place to a much further extent outwards than inwards, in consequence of the anterior crucial ligament. Whenever, therefore, lateral motion can be performed by the knee-joint, that limb is under circumstances least capable to resist accidents, or to support the weight of the body, which, therefore, is thrown entirely upon the other extremity, as we find to be the case in the act of walking.

DISLOCATIONS OF THE KNEE.

DISLOCATIONS OF THE PATELLA.

This bone being situated on the anterior part of the knee-joint is much exposed to external violence, and is proportionably liable to injury; amongst other accidents, it is subject to dislocation, which may take place either outwards or inwards.

The dislocation outwards, is the most frequent; it is, however, scarcely ever complete, unless it be from a very relaxed state of the ligaments, produced by some prior disease; but is usually thrown upon the external condyle, there forming a tumour, attended with loss of motion of the joint, which circumstances sufficiently point out the nature of the injury. This accident is frequently produced by a blow on the inner side of the patella when the foot is everted, or it may be

caused merely by the action of the extensor muscles of the leg; and in this case it most frequently occurs to such persons as have their knees directed very much inwards. If the dislocation be complete, the articular surfaces of the patella are thrown upon the external surface of the condyle, and its inner edge is placed anteriorly, which cannot take place without partial laceration of the ligamentum patellæ; unless, as I have before remarked, the accident be subsequent to the relaxation of the ligaments of the knee-joint from disease.

Dislocation inwards.—The appearances and symptoms differ in no respect from those of the preceding injury, excepting that the projection is situated internally instead of externally.

The *dislocations upwards* and *downwards*, which are spoken of by some surgeons, do not appear to me to deserve such appellation; but rather to be spoken of as either laceration of the ligamentum patellæ, when the bone is drawn upwards by the action of the extensor muscles, or as rupture of the tendon of the extensor muscles, when the patella is forced below its natural position.

The mode of reduction, when the patella is thrown either outwards or inwards, must at once be obvious to every surgeon; his object would be to place his only opposing force, the extensor muscles of the leg, in the greatest state of relaxation, which may be easily performed by laying the

patient in the horizontal position, with the injured leg extended, and the thigh flexed; and then, by forcing the patella either inwards or outwards, according to the direction of the luxation, it is easily reduced. These means should be employed as soon after the accident as possible, and bandages subsequently used, to keep the bone in its natural position; from which it would otherwise be easily again displaced by muscular action alone.

DISLOCATIONS OF THE TIBIA.

The tibia may be thrown from the articular surfaces of the condyles of the femur in four directions; but in consequence of the large surfaces of bone which are in contact for the formation of this joint, luxation is but rarely complete, and never without being accompanied with very extensive laceration of soft parts, unless, indeed, it be the result of protracted disease. But whatever may be the cause of displacement, the deformity is so great as at once to indicate the nature of the injury.

The tibia may be thrown forwards, backwards, or laterally, to either side of the knee.

Dislocation forwards.—In this luxation the head of the tibia is thrown before the condyles of the femur, which are thrust deeply into the popliteal region so as to compress the popliteal artery. The leg is shortened, this effect being produced by the laceration of the crucial, lateral, and posterior ligaments; and the extensor muscles of the foot, as well as the popliteus, must inevitably be stretched almost to laceration.

Dislocation backwards.—In this case the head of the tibia rests in the popliteal space; the leg is projected forwards by the pressure of the condyles of the femur upon the tubercle of the tibia, and the tendinous insertion of the extensor muscles of the thigh into the patella is torn through, leaving a depression above. Such is the account of this accident as given by Sir Astley Cooper, with whom some surgeons differ as to the position of the leg, whether it be inordinately extended, or permanently flexed; but as Sir Astley Cooper's description is derived from the history of a case furnished to him by an able and zealous professional man, under whose care the subject of the accident was placed, I shall esteem the account as positive, and not to be refuted by theoretical reasoning.

In the *lateral dislocations*, the projecting deformity sufficiently points out whether the luxation be *inwards* or *outwards;* in the first case the tibia is so thrown inwards

as to receive the external condyle on its outer articulatory surface, and the tibia projects on the inner side of the joint. Appearances precisely similar, excepting in situation, occur in the displacement of the tibia outwards.

The semilunar cartilages are sometimes partially displaced by the pressure of the femur, in consequence of relaxation of the ligaments of the knee-joint. This accident was first observed by Mr. Hey, of Leeds, and the symptoms have been most perspicuously and scientifically described by him, in his "Practical Observations on Surgery."

In few cases of dislocation of the tibia is there much difficulty in returning the bone to its situation, by reason of the laceration of the ligaments; but great care is required so to relax the muscles inserted into it as to prevent their action from again displacing the bone. This object is best effected by bandages, and by the semiflexed position of the limb.

The constitutional remedies will, necessarily, be directed by the peculiarities of each particular case.

ARTICULATION OF THE TIBIA AND FIBULA.

These two bones are in close contact at each extremity; but in the intermediate space there is a natural separation between them, which is filled up by the interosseous ligament. In this respect they are similar to the bones of the fore arm, except that they are firmly fixed to each other, while a very considerable degree of motion is allowed between the radius and the ulna.

UPPER FIBULO TIBIAL ARTICULATION.

There is a depression on the outer side of the head of the tibia, and a corresponding surface on the fibula, for the

attachment of these two bones; each is covered with cartilage and synovial membrane, and their union is strengthened by an anterior and posterior ligament.

The anterior ligament is of considerable strength and size. It passes from the outer part of the tubercle of the tibia outwards and downwards to be attached to the head of the fibula, and is covered and rendered stronger by the tendon of the biceps muscle.

The posterior ligament takes a very similar course to the preceding, being placed behind the articulation; its fibres are less strong, but support is afforded by the popliteus muscle which covers it.

A synovial membrane lines the internal surface of both these ligaments as well as the cartilaginous surface of the bones.

Notwithstanding the firmness of this junction there is some slight degree of motion, from before to behind, between the upper extremities of the tibia and fibula; luxation does sometimes occur, either from relaxation of its ligaments, or the application of force, and the fibula can be thrust backwards; it is, however, easily replaced, but with difficulty retained in its situation in consequence of the action of the biceps muscle; a strap should therefore be firmly applied to defend it.

I had an opportunity of seeing such a case very lately at Guy's Hospital, which was admitted under the care of

Mr. Key; in this there was a compound dislocation of the head of the fibula backwards from the tibia, attended with fracture of the fibula; the bone was so comminuted as to require the removal of its dislocated head.

MIDDLE FIBULO-TIBIAL ARTICULATION.

The tibia and fibula are connected nearly throughout their whole course by the *interosseous ligament*, which, as in the fore arm, fills up the natural separation of the two bones. It presents an aponeurotic expansion, composed of oblique fibres, which extend from within to without, arising from the external edge of the tibia, and passing to the inner spine of the fibula, terminating below on that bone, so that it is longer on the outer than on the inner side; and, as it forms an opening just above its termination, its lowest fibres, which pass from the inner side of the external malleolus to the tibia, are called the *inferior interosseous ligament*, which serves very considerably to protect the ancle-joint. The anterior surface of the interosseous ligament is covered by the flexor muscle of the foot, the extensors of the toes, and the anterior tibial vessels and nerve; its posterior face covers the extensor of the foot, and

the flexors of the toes. At the upper part of this membrane there is an opening for the transmission of the anterior tibial vessels, and some of the fibres of the tibialis posticus muscle. Through the lower interosseal opening, which I have already described, there passes a branch of the peroneal artery.

INFERIOR FIBULO-TIBIAL ARTICULATION.

This articulation is formed by two triangular articular surfaces; that on the fibula being convex, and that on the tibia concave; both these surfaces are covered by cartilage; the synovial membrane of the ancle-joint lines their internal surfaces, and the following ligaments strengthen their union.

The anterior ligament is triangular, larger below than above, and it passes from the lower extremity of the fibula to the fore part of the tibia. Its anterior surface is covered by the tendon of the peroneus tertius muscle; it serves to strengthen the articulation of the astragalus with the tibia and fibula, by rendering the cavity deeper in the anterior part.

The posterior ligament is composed of two fasciculi, separated from one another by an intervening space; the inferior fibres are sometimes called the *inferior posterior ligament.*

They both, however, arise from the back part of the malleolus externus, and pass inwards to be inserted into the back part of the tibia. They serve the same purpose as the anterior ligament, in rendering the articulation of the astragalus with the tibia and fibula much more secure, as well as in connecting those bones firmly together.

ARTICULATION OF THE ANCLE-JOINT.

The inferior extremities of the tibia and fibula form a socket for the reception of the upper part of the astragalus; this socket is rendered much deeper by the projection of the two malleoli on either side of the astragalus, and it is further completed by the anterior and posterior ligaments, which have just been described, connecting the tibia and fibula below. The surfaces of bone entering into this joint are covered by cartilage and synovial membrane, and are maintained in their situation by two ligaments from the tibia, and three from the fibula.

The internal lateral or *deltoid ligament,* is of a triangular form; its apex is attached to the internal malleolus; it then passes downwards, becoming broader as it descends, and is inserted into the inner side of the astragalus and os calcis;

forming, where it is attached to the latter bone, a sheath for the transmission of the tendons of the long flexors of the toes and the tibialis posticus, which pass behind the internal malleolus to be inserted. There is also an *anterior ligament* from the tibia, which passes from the fore part of this bone to be attached to the anterior surface of the astragalus; the tendons of the extensor muscles of the toes pass over it.

The external lateral or *perpendicular ligament of the fibula*, is composed of straight fibres, which are strong, and rounded in their form, passing from the inferior extremity of the malleolus externus perpendicularly downwards, to be inserted into the upper part of the os calcis; its external surface is covered by the tendons of the peronei muscles; internally, it is lined by synovial membrane.

The anterior ligament of the fibula, arises from the anterior part of the external malleolus, and passes downwards and inwards to be attached to the fore part of the astragalus.

The posterior ligament of the fibula, takes much the same course as the preceding ligament, but is situated behind the joint; it passes from the back part of the malleolus externus, and is inserted into the posterior part of the astragalus.

The synovial membrane.—This membrane secretes a larger quantity of synovia than any in the body. It extends from the cartilaginous surfaces of the tibia and fibula upwards,

between these two bones, as high as the inferior fibulo-tibial articulation. It then prolongs itself on the cartilaginous surfaces of the two malleoli, covers all the ligaments of the ancle-joint, and rises upon the articulatory surfaces of the astragalus; before and behind it is very lax, and is connected with a considerable quantity of adipose membranes.

MOTIONS OF THE ANCLE-JOINT.

The foot, through the medium of the ancle-joint, has the motions of flexion, extension, and lateral inclination.

Flexion.—During this motion, the astragalus passes from before backwards within the cavity formed by the tibia and fibula. The anterior ligaments are relaxed, and the posterior are put upon the stretch; but the lateral remain much in their natural state.

Extension.—In this action the foot is carried from the right angle with the leg, so as to form an obtuse one; the anterior part of the articular surface of the astragalus leaves the cavity between the tibia and fibula in the opposite direction to that in which it was kept by the last motion; and the posterior and smaller part of the astragalus passes forwards. In this action the lateral motion of the joint is allowed, in consequence of the comparatively smaller size of the astragalus, behind, by

which it is incapable of filling up the whole space between the tibia and fibula. During extension of the foot the anterior ligament is put upon the stretch, the posterior is relaxed, while the lateral remain unaltered as to their degree of tension.

Lateral motions, are extremely confined under every natural condition of the joint; in fact, they cannot be separately distinguished from the motions of the bones of the tarsus between each other. They may, however, be performed to some small extent under the circumstances that exist during the extension of the foot, as already described; and, therefore, this being allowed, a fourth motion must be ascribed to the joint, viz., circumduction.

DISLOCATIONS OF THE ANCLE-JOINT.

NOTWITHSTANDING the numerous and strong ligaments which serve to connect the tibia and fibula with the bones of the tarsus, yet, from the great degree of violence to which the ancle-joint is constantly exposed, luxation does frequently occur; and as it is usually attended with great injury and laceration to the parts entering into the composition of the joint, the accident is one of a dangerous nature.

The tibia may be thrown from the astragalus in four different directions; but the fibula, having its ligaments so strong in proportion to its articular surface, usually breaks, rather than separate from its connection with the astragalus.

The tibia may be thrown inwards, outwards, forwards, or backwards.

The dislocation inwards, is the most common; and in this accident the foot is turned outwards, so that only its inner edge rests upon the ground; the internal malleolus is depressed, and occupies a space on the inner side of the astragalus below its articular surface; the fibula is broken about two inches above the joint, and the lower portion is drawn by the tibia across the astragalus; the external malleolus remains in its natural situation. If this accident be produced by a person jumping from a considerable height, that portion of the tibia which is connected to the fibula by the anterior and posterior ligaments is liable to be broken off.

Dislocation of the tibia outwards.—This accident is attended with comminution of bone, and considerable injury to soft parts; and in every respect offers a less favourable prognosis than the preceding luxation. The foot is turned inwards, resting on the outer edge, the malleolus internus is broken off the shaft of the tibia, and the fibula, at its lower extremity, is usually fractured: but it is said sometimes to happen, that the ligaments connecting the fibula to the tarsus are ruptured; and, in that case, the bone remains whole. The external malleolus projects forcibly on the outer side of the foot, so as to threaten the laceration of the skin.

Dislocation of the tibia forwards, is produced by the tibia passing forwards off the articular surface of the astragalus, and

resting upon the navicular bone; the consequences are great shortening of the foot between the lower part of the leg and extremity of the toes, together with elongation of the heel; the foot is extended and fixed in this position, admitting of no motion; the fibula is broken, its ligaments of course remain whole; but some of the posterior fibres of the deltoid ligament are ruptured. This dislocation is sometimes only partial, so that one half of the articular surface of the tibia rests upon the astragalus, while the anterior half projects forward over the navicular bone; the foot is extended, and the fibula broken; but it may be at once distinguished from the complete luxation, by the shortening of the foot and elongation of the heel being infinitely less than in the preceding accident.

Dislocation of the tibia backwards.—This is an accident of extremely rare occurrence, for it appears never to have fallen under the observation of any author who has written upon the subject of dislocation; but should it occur, the lengthened state of the anterior part of the foot, with the shortening of the heel, would at once be sufficient diagnostic marks to point out the nature of the injury. Luxations incident to the ancle-joint, may occur in the compound, as well as in the simple state; and the grand distinction between the two accidents, is, that in the latter case the synovial cavity

is laid open by the laceration of the skin, and the articular surfaces of bone are exposed. Even in these accidents it is now proved by experience, that amputation is not the necessary resort; for if there be youth and constitution, the preservation of the limb should be attempted, in every case where there is not a division of any large blood-vessel, or any extraordinary degree of laceration of the soft parts; and it may very frequently be effected by strict attention to the unfavourable symptoms that supervene, and the judicious application of remedies to overcome them.

With respect to the reduction of these dislocations, whether simple or compound, the means should be employed as soon as possible after the accident; and in all cases, the leg should be flexed, so as to relax the opponent muscles.

LIGAMENTS OF THE TARSUS.

The bones of the tarsus are, at those points in which they come in contact, covered with cartilage and synovial membrane; and these attachments are further strengthened by strong ligaments, which may be distinguished on the plantar, dorsal, external, and internal regions of the foot.

The articulation of the astragalus with the os calcis.—These two bones are articulated by two cartilaginous surfaces, which are covered by synovial membrane, and maintained in their situation by an interosseous, a posterior, and an external lateral ligament.

The interosseous, or *sub-astragalar ligament*, is formed of strong thick fibres, which are situated between the astragalus and os calcis, being attached to the fossæ which separate the articular surfaces on each of those bones. This ligament is thicker on the outer than on the inner side.

The posterior ligament, arises from the back part of the astragalus, and directs itself obliquely inwards to be inserted into the corresponding part of the os calcis; it is connected with the groove which is formed in the os calcis for the passage of the flexor tendon of the great toe.

The external ligament, forms a rounded fasciculus, the fibres of which run in the same direction as the external fibulo tarsal ligament, passing from the external face of the astragalus to the outer surface of the os calcis.

The articulation of the os calcis and os naviculare.—In this articulation the surfaces of bone are not in contact, but the union is formed by two very strong ligaments. The *inferior* is very strong, almost cartilaginous in its texture, and extends from the smaller tuberosity of the os calcis as far as the inferior surface of the scaphoid bone; in its passage from one bone to the other it rests upon the tendon of the tibialis posticus muscle; and above, it receives a portion of the astragalus. The *external* are very short fibres, and stretch from the anterior part of the calcis to the inferior and outer edge of the scaphoid bone.

Articulation of the astragalus to the os naviculare.—The anterior extremity of the astragalus is rounded and fitted to a concave surface upon the posterior extremity of the navicular bone, both of which surfaces are covered by synovial mem-

brane, and strengthened by one broad superior ligament, which covers the whole superior surface of the two bones; it is composed of very thin fibres, which are directed from behind to before; some of its anterior fibres pass to the cuneiform bones.

The articulation of the calcis to the cuboid bone.—The articular surfaces of these two bones, which are in contact, are maintained in that situation by two ligaments, and covered by synovial membrane.

The superior ligament, stretches from the superior and anterior part of the os calcis to the superior surface of the cuboid bone; this ligament covers the synovial membrane, and is covered by the peroneus tertius muscle.

The inferior ligament, is very thick and extensive; it is composed of two sets of fibres, the superficial and the deep. The *superficial ligament* is the strongest of the tarsal ligaments; it is attached behind to the posterior and inferior part of the os calcis, and anteriorly, in part to the tuberosity on the inferior surface of the cuboid bone, and also to the extremities of the metatarsal bones of the little toe and toe next to it. The *deep ligament* has the same attachment to the os calcis and the os cuboides as the preceding ligament, but is above it, and separated from it by a layer of fat.

Articulation between the os naviculare and os cuboides.—

These two bones are connected together by two strong ligaments; one being situated on the dorsal region of the foot, and the other on the plantar. The *dorsal ligament* is of a square shape; its fibres take a transverse course from the navicular to the cuboid bone. The *plantar ligament* is composed of stronger fibres, and passes from the inferior and external parts of the navicular to the cuboid bone.

Articulation of the cuboid with the external cuneiform bone.—These two bones present articular surfaces, which are in contact, and are covered by synovial membrane; they are maintained more firmly in their situations by a *dorsal* and a *plantar* ligament, which pass from the superior and inferior surfaces of one bone to the other, covering the synovial capsule.

Articulation of the navicular with the cuneiform bones.—The anterior face of the navicular bone presents three surfaces for the junction of the three cuneiform bones, which are all covered with cartilage and synovial membrane. Three dorsal and three plantar ligaments also enter into the formation of this union. The *dorsal* pass from the superior and anterior surface of the navicular to be attached to each of the cuneiforme bones. The *plantar ligaments* take precisely the same course, but are situated in the sole of the foot.

Articulation of the cuneiform bones.—The cuneiform bones

are attached to each other at their sides, each presenting an articular surface, which is covered by synovial membrane, and strengthened by three superior, and three inferior ligaments.

The superior ligaments pass transversely from one bone to the other, forming a species of interosseous ligament. The *inferior ligaments* are precisely similar in their course, but are situated in the plantar region of the foot.

The articulation of the tarsus and metatarsus.—The three first bones of the metatarsus are articulated with the cuneiform bones; and the two last, or outer ones, with the cuboid. Their articular surfaces are covered with cartilage and synovial membrane, and are further united by dorsal and plantar ligaments.

The dorsal ligaments are composed of thick short parallel fibres, three of which pass from the superior part of the cuneiform bones, to be attached to the extremities of the metatarsal bones; and the outer ones pass in the same manner, from the superior surface of the cuboid bone, to the two outer metatarsal bones.

The plantar ligaments are also five in number, and are disposed precisely in the same manner.

The articulation of the metatarsus.—All the bones of the

metatarsus, excepting the first, are in contact with one another at their superior extremities, and present small articular surfaces, which are covered with synovial membrane, and maintained in their respective positions by *dorsal* and *plantar ligaments*, of which there are three on each region, passing transversely from one bone to the other, excepting from the first to the second.

The interosseous ligaments are also situated between the metatarsal bones, and serve to strengthen the articulation of these bones, and to give origin to the interossei muscles.

The transverse ligament.—The anterior extremities of the metatarsal bones are united by this ligament, which passes from the inferior extremity of one bone to the other, precisely in the same manner as in the metacarpus.

The articulation of the metatarsus and phalanges.—The superior extremities of the phalanges are articulated with the heads of the metatarsus; and they are connected by ligaments similar to those which form the junction between the phalanges and metacarpus.

The articulation of the phalanges of the toes is so precisely analogous to that of the fingers, as to render its further description quite useless.

The *motions* between the bones of the tarsus are but very

slight; there are, however, two very important joints, which cross the tarsus in a direct line; the inner one is formed by the astragalus and navicular bones, and the outer one by the os calcis and the cuboid. Slight lateral motion is allowed between these bones.

DISLOCATION OF THE BONES OF THE TARSUS.

THEIR motions being limited, and their bonds of union so firm and strong, luxation is of rather rare occurrence, and can only be produced by great violence; under which circumstance, however, the astragalus may be separated from the os calcis, and the os calcis and astragalus may be luxated from the cuboid and navicular bones. The internal cuneiform bone is also liable to dislocation. These injuries are fully described by Sir Astley Cooper.

The other bones of the tarsus and metatarsus are too strongly connected to admit of separation, unless, indeed, it be attended with total destruction of the foot.

The phalanges of the toes are so short, as to render their displacement an improbable accident; excepting that of the first bone of the great toe from the metatarsal bone, which not unfrequently occurs, but is easily reduced.

FINIS.

EXPLANATION OF PLATES.

PLATE 1.

Fig. 1.

Fig. 2.

Fig. 3.

John Graves delt.

Published by Bransby B. Cooper. 1825.

Js. Basire sculpt.

PLATE I.

Fig. 1.

Represents the temporo-maxillary articulation, seen from without.

1. The squamous portion of the temporal bone.
2. Superior part of the lower jaw.
3. The external lateral ligament.

Fig. 2.

Exhibits the same joint, with the capsule of the joint opened to expose the interarticular cartilage.

1 2 3. The same as in figure 1.
4. The superior synovial cavity exposed.
5. The interarticular cartilage dividing this articulation into two distinct synovial cavities.

Fig. 3.

Represents the same articulation from within.

1. The concave part of the squamous portion of temporal bone.
2. Inner surface of inferior maxillary bone.
3. Internal lateral ligament.
4. Stylo-maxillary ligament.
5. Interarticular cartilage.

FIG. 1.

PLATE II.

FIG. 2.

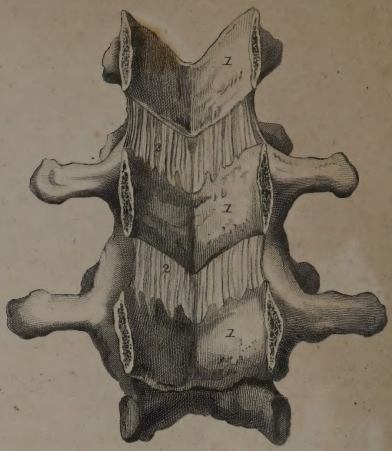


FIG. 3.

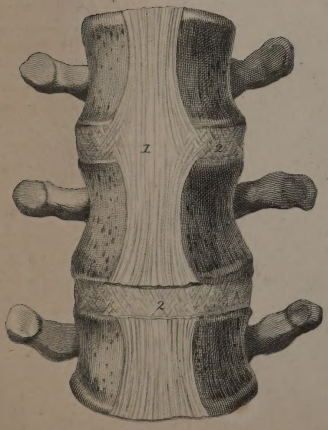
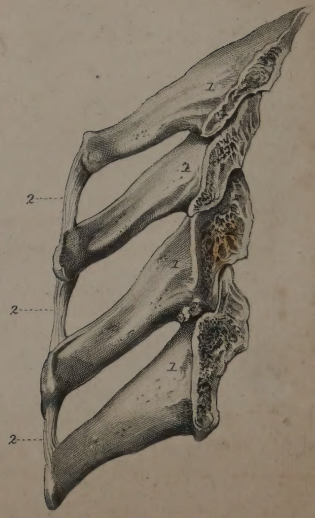


FIG. 4.



John Graves delt.

Published by Bransby Cooper. 1824.

Canton sculp.

PLATE II.

Represents the different ligaments common to the spinal column.

Fig. 1.

1. The basilar process of the occipital bone.
2. The anterior portion of the circular ligament.
3. The common anterior ligament of the vertebræ.
4. The fibrous capsules connecting the articular processes of the vertebræ.
5. The intervertebral substance.

Fig. 2.

1. The arches of the vertebræ seen from within.
2. The ligamentum subflavum.

Fig 3.

1. Common anterior ligament.
2. Intervertebral substance; the anterior ligament removed to exhibit the crucial fibres passing over it.

In this figure the anterior ligament is shown on the dorsal vertebræ, where it is stronger and broader than on the others.

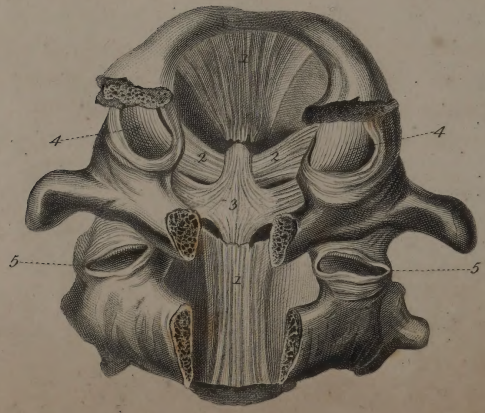
Fig. 4.

1. The spinous processes of the dorsal vertebræ.
2. The interspinous ligaments.

PLATE III.

Fig. 1.

Fig. 2.



John Graves delt.

Canton sculpt.

Published by Bransby B. Cooper, 1825.

PLATE III.

Exhibits the ligaments proper to certain vertebræ.

Fig. 1.

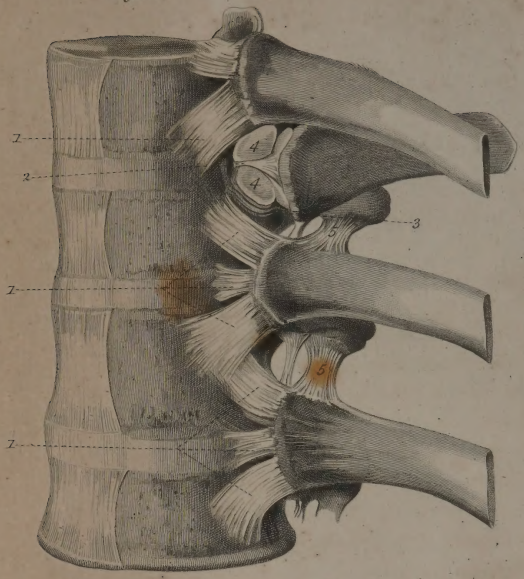
1. The common posterior ligament continued from the basilar process of the occipital bone down the spine, applied to the posterior surfaces of the bodies of all the vertebræ.
2. The anterior circular ligament seen from behind.
3. The alar or lateral ligaments.
4. The transverse ligament.
5. The capsular ligament connecting the articular surfaces of the atlas and occiput.

Fig. 2.

1. The common posterior ligament of the vertebræ, cut through to expose the processus dentatus of the second vertebra and its ligaments: the upper portion of the posterior ligament has been called the perpendicular.
2. The alar or lateral ligaments attached to the apex of the tooth-like process.
3. The transverse ligament; some of its fibres are continued up to the apex of this process; some, descending, are lost in the posterior ligament.
4. The joint between the atlas and dentata laid open.
5. The joint between the second and third vertebræ also exposed.

PLATE IV.

Fig. 1.



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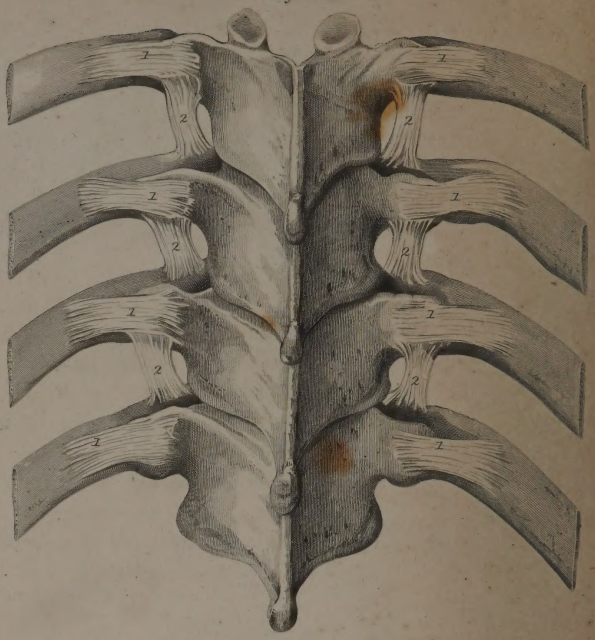


Fig. 3.

John Graves delt.

Carton sculpt.

Published by Bransby B. Cooper, 1825.

PLATE IV.

The ligaments connecting the ribs to the vertebræ are here shown.

Fig. 1.

1. The fibrous capsule or ligament of the head of the rib; some of its fibres passing obliquely upwards, some in an opposite direction to be attached to the bodies of the vertebræ above and below; while the middle fibres pass straight over to be attached to the intervertebral substance.
2. The interarticular ligament of the head of the rib.
3. The head of the rib disarticulated to shew the interarticular ligament between
4 4. The articular surfaces on the bodies of the vertebræ above and below.
5 5. The internal ligament of the neck of the rib.

Fig. 2.

1. The external transverse ligaments.
2. The external ligament of the neck of the rib.

Fig. 3.

1. The articular surfaces of the transverse process of the dorsal vertebræ.
2. The fibrous capsule surrounding this articulation.
3. The fibrous capsule of the head of the rib.

PLATE V.

Fig. 1.

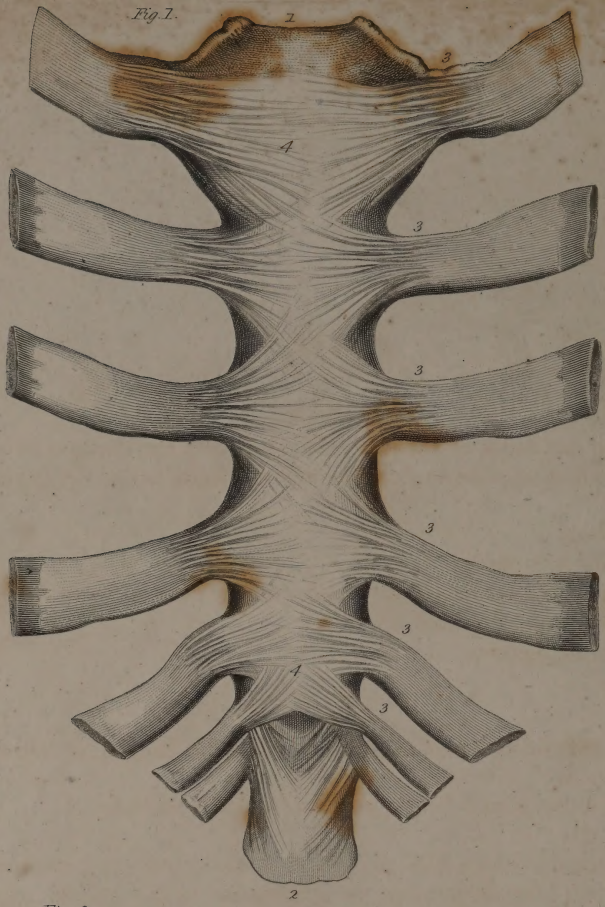


Fig. 2.

John Graves del.t

Canton sculp.t

Published by Bransby B. Cooper. 1825.

PLATE V.

Fig. 1.

Shews the cartilages of the ribs connected with the sternum by means of ligaments, which expand to form the anterior ligament of the sternum.

1. The sternum.
2. The ensiform cartilage.
3 3 3, &c. The ligamentous fibres passing off the extremities of the cartilages to the sternum, expanding to form
4. The anterior ligament of the sternum.

Fig. 2.

Shews the ligament attaching the last rib to the lumbar vertebræ.

1 1. The last dorsal and two uppermost lumbar vertebræ.
2. The last rib.
3. The ligamentum arcuatum passing from the transverse processes of the upper two lumbar vertebræ to be attached to the inferior edge of the twelfth rib. Its superior surface is connected with the diaphragm; its anterior is covered by the quadratus lumborum.

PLATE VI.

John Graves del.

J.s Basire sculp.

Published by Bransby B. Cooper, 1825.

PLATE VI.

Represents the ligaments of the upper extremity.

Fig. 1.

Shews the ligaments which connect the clavicle and humerus to the scapula.

1. The clavicle.
2. The anterior part of the scapula.
3. The coracoid process.
4. The acromion process.
5. The humerus.
6. The ligaments binding the scapular end of the clavicle to the acromion, or the acromio-clavicular.
7. The trapezoid or anterior } coraco-acromion ligaments.
8. The conoid or posterior }
9. The common posterior ligament of the notch.
10. The deltoid or acromio-coracoid ligament.
11. The capsular ligament of the shoulder-joint.
12. The long head of the biceps, which, although covered and under the capsule, is yet anterior and external to the synovial membrane.

Fig. 2.

1. The sternum.
2 2. The clavicles.
3 3. The first ribs.
4 4. The fibrous capsules of the sterno clavicular articulations; the joint of the left side is laid open to shew
5. The interarticular cartilage.
6 6. The rhomboid or costo clavicular ligaments.
7. The interarticular ligaments.
8 8. Ligaments passing from the cartilage of the rib to the sternum.

Fig. 3.

1. The acromion.
2. The coracoid processes.
3. The glenoid cavity of the scapula.
4. The cotyloid ligament.
5. The tendinous or long head of the biceps.

PLATE VII.

Fig. 1.

Fig. 2.

Fig. 5.

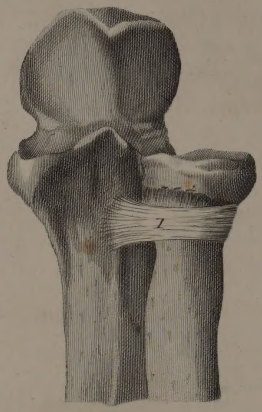


Fig. 3.

Fig. 4.

John Graves del.t

James Basire sculp.t

Published by Bransby B. Cooper, 1825.

PLATE VII.

Fig. 1.

An anterior view of the ligaments of the elbow-joint.

1. The common anterior ligament.
2. The oblique ligament.

Fig. 2.

Posterior view of the same.

1. The posterior ligament.
2. The external } lateral ligaments.
3. The internal }

Fig. 3.

1. Represents the external lateral, and

Fig. 4.

1. The internal lateral ligaments of the elbow-joint.
2. The anterior ligament.
3. The annular.
4. The oblique ligament.

Fig. 5.

Shews how the radius is attached above to the ulna by means of

1. The annular or coronary ligament.

PLATE VIII.

Fig. 1.

Fig. 2.

John Graves del.

James Basire sculp.

Published by Bransby B. Cooper, 1825.

PLATE VIII.

Represents an anterior and posterior view of the ligaments of the hand.

Fig. 1.

The posterior view.

1. Interosseous ligament.
2. Posterior ligament of the inferior radio-ulnar articulation.
3. Posterior ligament of the wrist-joint.
4. External lateral ligament.
5. Internal lateral ligament.
6. Continuation of the internal lateral ligament from the cuneiform bone to the unciform bone.
7. Fibres which pass from the scaphoid to the trapezium, and from thence to the metacarpal bone of the thumb.

8 8 8, &c. Posterior carpo metacarpal ligaments.

Of the thumb.

1. Internal lateral ligament of the metacarpo phalangeal articulation.
2. Capsular ligaments of ditto. Phalangeal articulation of ditto.
3. Internal lateral ligament of the phalangeal articulation.
4. Capsular ligament of ditto.

Of the fingers.

1 1 1. Internal lateral ligaments of the metacarpo phalangeal joints.
2 2. External lateral ligaments of the metacarpo phalangeal joints.
3 3, &c. Capsular ligaments of ditto.
4 4 4. Intermetacarpal ligaments.
5. External lateral ligaments of the phalangeal joints.
6. Internal ditto.
7. Capsular ligaments of ditto.

Fig. 2.

Represents the anterior view of the same joints.

1. Transverse bands connecting the ulna to the radius.
2. Internal lateral ligaments of the wrist.
3. External lateral ditto.
4. Common anterior ligaments.
5. Ligaments passing anteriorly from the pisiform bone to the metacarpal bone of the little finger.
6. Fibres passing from the scaphoid to the trapezium.

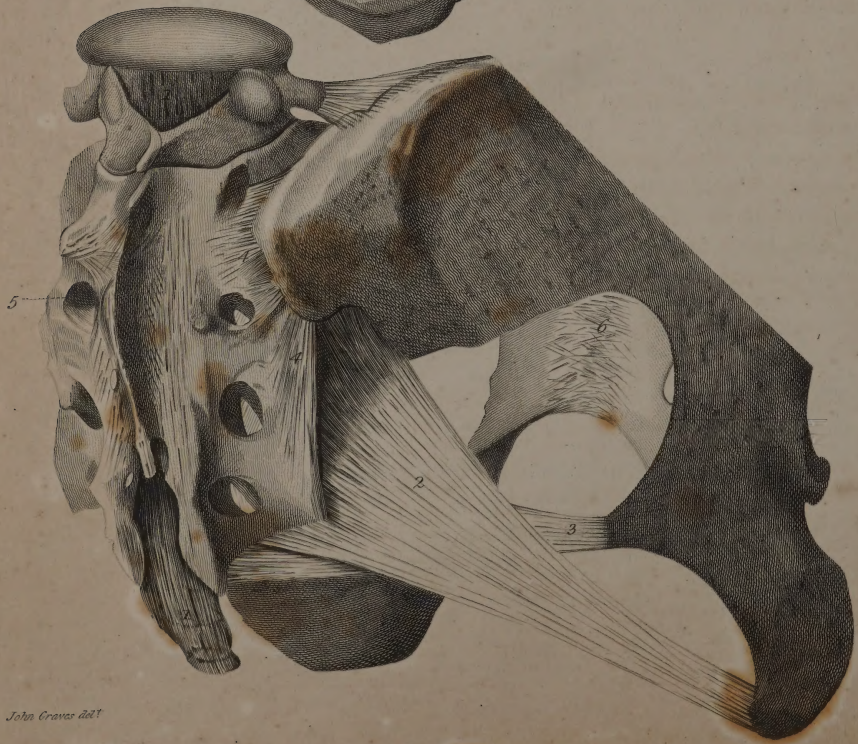
7 7. Anterior interosseous carpal ligaments.

The figures referring to the thumb and fingers having been before explained, it is unnecessary to repeat them here.

PLATE IX.

Fig. 1.

Fig. 2.



John Cravos del.

James Basire sculp.

Published by Bransby B. Cooper, 1825.

PLATE IX.

Fig. 1.

1 1. Common anterior ligament of the vertebræ, continued upon the sacrum to the termination of the os coccygis.
2 2. The sacro lumbar ligament.
3 3. Ilio lumbar ligament, separating into two fasciculi.
4. Cotyloid ligament.
5. Sacro iliac ligament.
6. Anterior ligament of the pubes.
7. Obturator ligament.

Fig. 2.

1 1. Common posterior ligament of the vertebræ, continued upon the sacrum to the os coccygis.
2. Posterior sacro sciatic ligament.
3. Anterior sacro sciatic ligament.
4 4. Posterior sacro iliac ligament.
5. Ligamentous bands connecting the spinous processes of the sacrum.
6. Posterior ligament of the pubes.

PLATE X.

Fig. 1.

Fig. 2.

John Dalrymple del.

St. Basire sculpt.

Published by Bransby B. Cooper, 1825.

PLATE X.

Fig. 1.

1. Os innominatum with the acetabulum.
2. Head of the femur.
3. Ligamentum teres.
4 4. Capsular ligament laid open, to shew the head of the femur within the acetabulum, and
5. The reflected synovial membrane.

Fig. 2.

1. The acetabulum.
2. Head of the femur drawn out of the acetabulum, to shew the attachment of
3. The ligamentum teres.
4 4. Cotyloid ligament.

PLATE XI.

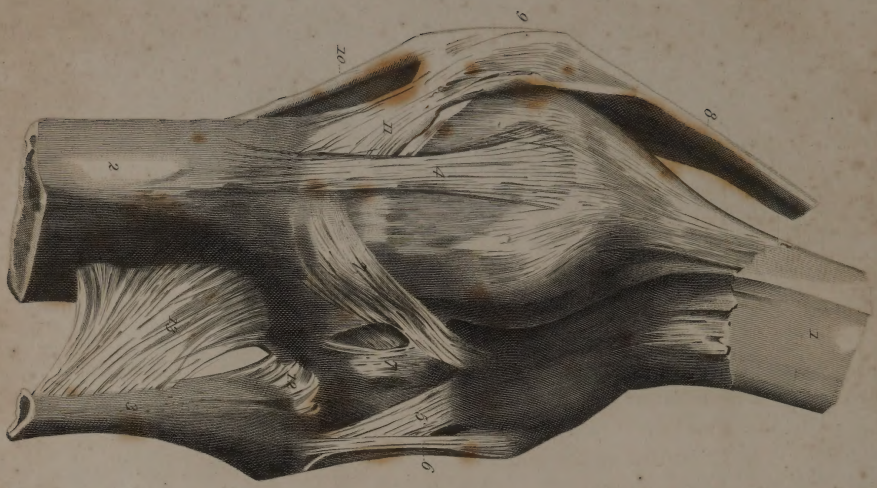


Fig. 1.

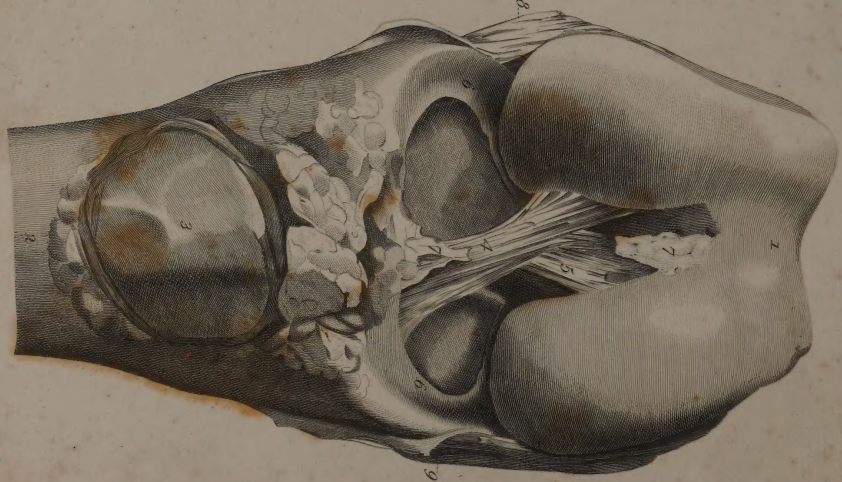


Fig. 2.

John Graves delt

Published by Bransby B. Cooper, 1825.

Js Basire sculpt

PLATE XI.

Fig. 1.

1. The femur.
2. The tibia.
3. Fibula.
4. Internal lateral ligament.
5. Short external lateral ligament.
6. Long external lateral ligament.

7 7. Posterior ligament of Winslow.

8 Tendinous insertion of the extensor muscles of the leg.

9. Patella.
10. Ligament of the patella.
11. Alæ ligaments.
12. Posterior ligament of the superior tibio fibular articulation.
13. Interosseous ligament.

Fig. 2.

1. The femur.
2. Tibia.
3. Patella.
4. Anterior crucial ligament.
5. Posterior crucial ligament.

6 6. Semilunar cartilages.

7 7. Mucous ligament only left at its attachments, the middle half being removed to shew the crucial ligaments.

8. External lateral ligament.
9. Internal lateral ligament.

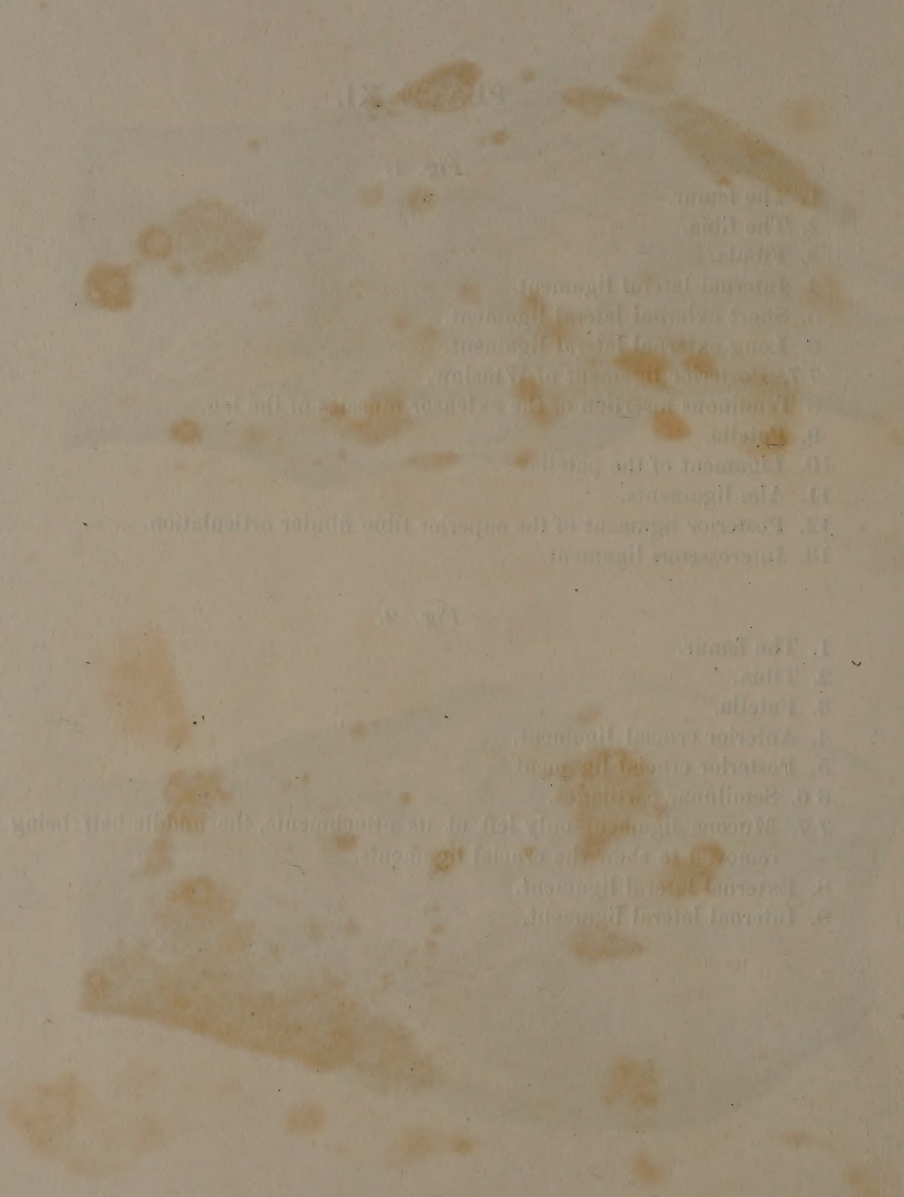


PLATE XII.

Fig. 1.

Fig. 2.

John Graves del.

J. Basire sculp.

Published by Bransby B. Cooper. 1825.

PLATE XII.

Fig. 1.

1. The tibia.
2. Os calcis.
3. Navicular bone.
4. Internal cuneiform bone.
5. Metatarsal bone of the great toe.
6. Astragalus.
7. Deltoid or internal tibio tarsal ligament.
8. Dorsal ligament connecting the astragalus and navicular bones.
9. Dorsal ligament connecting the navicular with the internal cuneiform bone.
10. Tarso metatarsal articulation of the great toe.

Fig. 2.

1. Fibula.
2. Tibia.
3. Interosseous ligament.
4. Anterior ligament of the inferior tibio fibular articulation.
5. Anterior fibulo tarsal ligament.
6. External fibulo tarsal or lateral ligament.
7. Dorsal interosseous ligaments of the tarsus, gaining their respective names from the different bones which they serve to connect.

8 8. Dorsal tarso metatarsal ligaments.

PLATE XIII.

Fig. 1.

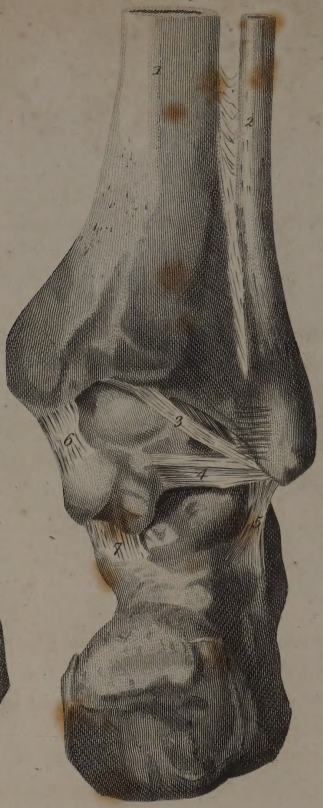


Fig. 2.

Fig. 3.

John Graves del.t

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J.t Basire sculp.t

PLATE XIII.

Fig. 1.

Posterior view of the ligaments of the ancle-joint.

1. Tibia.
2. Fibula.
3. Posterior ligament of the inferior tibio fibular articulation.
4. Posterior fibulo tarsal ligament.
5. External fibulo tarsal ligament.
6. Posterior edge of the deltoid or internal tibio tarsal ligament.
7. Ligament posteriorly connecting the astragalus with the os calcis.

Fig. 2.

1. Fibula.
2. Tibia.
3. Astragalus.
4. Anterior ligament of the inferior tibio fibular articulation.
5. Anterior fibulo tarsal ligament.
6. Anterior surface of the deltoid or internal lateral ligament.
7. Dorsal interosseous tarsal ligaments.
8. Dorsal tarso metatarsal ligaments.
9. Dorsal surface of the intertransverse metatarsal ligaments.

Fig. 3.

1. Os calcis.
2. Inferior plantar ligament.
3. Superior plantar ligament.
4. Plantar interosseous tarsal ligaments.
5. Plantar tarso metatarsal ligaments.
6. Plantar surface of intertransverse metatarsal ligaments.

EXPLANATION OF PLATE—Page 77.

Fig. 1.

1. The inferior extremity of the ulna.
2. The inferior articulating extremity of the radius.
3 3. First range of carpal bones.
4. The interarticular cartilage opposed to the cuneiform bone.

Fig. 2.

1. The ulna.
2. The radius.
3. The first carpal range.
4. The interarticular cartilage turned back to shew its continuation from
5. The cartilage lining the sigmoid cavity of the radius.

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